Author:
Frenkel, Heather Frances

Title:
A health education intervention to improve oral health among institutionalised elderly people : a randomised controlled trial.

A health education intervention to improve oral health among institutionalised elderly people: a randomised controlled trial

Heather Frances Frenkel

A dissertation submitted to the University of Bristol in accordance with the requirements of the degree of Doctor of Philosophy in the Faculty of Medicine

August 1998

52,160 words

Abstract

This cluster-randomised controlled trial evaluated an oral health care education programme (OHEP) for carers of nursing-home clients. Outcome measures were carers' knowledge and attitude scores (assessed by questionnaire) and clients' oral health status (clinically assessed). Data were collected at baseline, and at one-month and six-months after OHEP. The sample, comprising 412 clients and 295 carers in 22 homes, showed acceptable baseline comparability.

Clients' baseline oral health was poor. After OHEP, several intervention group oral health scores improved significantly. Reductions in intervention group denture plaque scores (0-4 scale) exceeded those of the control group by 1.14 (95%CI 1.28 to 1.01) at one month and by 1.46 (95%CI 1.64 to 1.29) at six months. Denture-induced stomatitis prevalence reduced over 6 months by 20.3% in the intervention group compared to 4% in the control. For dental plaque (0-3 scale), group differences in favour of the intervention group were 0.42 (95%CI 0.58 to 0.25) at one month and 0.34 (95%CI 0.53 to 0.15) at six months. For gingivitis (0-2 scale), differences were 0.17 (95%CI 0.32 to 0.02) at one month and 0.28 (95%CI 0.42 to 0.15) at six months. These key differences remained significant after adjustment for clustering effects. Differences for measures unlikely to change without professional dental treatment (calculus, root caries, tooth mobility) were not significant.

Carers' knowledge scores increased in both groups. The intervention group improved more than the control, differences being statistically significant at both response times ($p=0.003$, $p=0.001$ respectively). Attitude scores increased in the intervention group, but fell in the control. Differences were statistically significant at both response times ($p=0.003$, $p<0.001$). Participants rated the OHEP positively.

Although final levels of residents' oral health were still short of ideal, this study clearly shows that an OHEP can improve carers' knowledge, attitudes and oral health care performance for elderly, functionally dependent clients.

Acknowledgements

I would especially like to thank my advisers, Dr. Ian Harvey of the Department of Social Medicine, University of Bristol (now Professor of Epidemiology and Public Health at the School of Health, Policy and Practice, University of East Anglia) and Professor Alan Harrison of the Department of Oral and Dental Science, University of Bristol for their unfailing support and constructive advice. I am also very grateful to Professor Martin Addy for his encouragement during this project and for the benefit of his expertise in dental surveys.

I am indebted to Mrs. Kathy Needs for her dedication and enthusiasm in delivering the health education programme, to Mr. Richard Vowles for constructing the database for the survey of nursing home clients, and to Dr. Robert Newcombe of the University of Wales College of Medicine, Cardiff for his valuable assistance in the statistical analysis of the client survey and for the many helpful discussions that took place.

Finally, I would like to express my deep gratitude to my husband, John, who generously redefined his domestic role in order that I might devote more time to my research, and to Bette Baldwin, my fellow member of a two woman mature postgraduate student support group, for sharing with me the experience of completing a PhD thesis while continuing to work at a 'proper job'.

This work was wholly supported by the following grants:

- NHS Research and Development Directorate Research Studentship S/03/Frenkel/95 (1995-98)
- NHS Research and Development Directorate Project Grant D/01/5-95/Frenkel (1995-98)

Author's declaration

I declare that the work in this dissertation was carried out in accordance with the regulations of the University of Bristol. The work is original except where indicated by special reference in the text and no part of the dissertation has been submitted for any other degree.

Any views expressed in the dissertation are those of the author and in no way represent those of the University of Bristol.

The dissertation has not been presented to any other University for examination either in the United Kingdom or overseas.

H F Frenkel

20 August 1998

Table of contents

List of tables

List of figures

Chapter 1

INTRODUCTION

1.1 Background to the study

The impetus for this study came from the researcher's observations, when providing dental treatment in nursing homes, of the low standard of denture and dental hygiene among clients. Since functional disability is the main reason for nursing home admission (Coni *et al.*, 1993), the majority of residents were likely to rely on carers' assistance for personal care, including oral hygiene procedures. The quality of carer-delivered oral or denture hygiene was likely to depend on carers' oral health care knowledge, their attitudes towards clients' personal oral care and, it was hypothesised, the training they received. Clearly, there were major deficiencies in one or more of these elements affecting the quality of oral health care offered to clients.

A review of literature revealed that concern for the oral health status of institutionalised elderly people in the United Kingdom (UK) was first voiced over 25 years ago (Ritchie, 1973). Up to the present day, oral health in nursing home clients in all parts of the developed world has been the subject of many subsequent studies, some of the most recent being Jokstad *et al.* (1996) and Knabe & Kram (1997). Despite a substantial body of evidence on the lamentable oral status of institutionalised elderly people, depressingly little seems to have changed over the years. Most studies have been confined to cataloguing parameters of oral health. Many recommended education and training of care staff as a method of improving oral health status among functionally dependent institutionalised elderly people. However, very few studies attempted to change dental behaviour or oral health in nursing homes or similar settings.

Where educational initiatives had been made, there was little evaluation of their effectiveness. Among researchers studying training for carers, some assessed the acceptability of programmes to participants (Munday & Gelbier,1984; Eadie & Schou, 1992), some assessed changes in carers' knowledge (Davies & Whittle, 1990; Glassman *et al.*, 1994; Kite, 1995), but only two assessed how carers' training

affected the oral health status of clients (Nicolaci & Tesini, 1982; Vigild, 1990). However, in the preventive model of health education (Tones & Tilford, 1994), the education process encompasses all the elements assessed separately in the above studies. Attitude is seen as the trigger that converts knowledge into practice, which in turn, can lead to prevention and control of disease. The present study is therefore unusual, being designed to appraise the education process as a whole by assessing a wide range of knowledge, attitude and oral health parameters in a general population. The large sample size, extended follow-up period and robust controlled trial design are also relatively uncommon in health education evaluation studies; equally unusual is the choice, as a study sample, of elderly subjects, who are rarely considered as possible beneficiaries of health promotion (Brown, 1994).

Previous research indicated that little change in oral health may be achieved by a direct approach to educating or changing the behaviour of frail, elderly nursing home clients (Schou *et al.*, 1989). However, education and training of dependent individuals' carers has resulted in more encouraging oral health outcomes among clients (Nicolaci & Tesini, 1982; Vigild, 1990). It was this latter pathway that the present study was designed to implement and evaluate in a sample of nursing homes within the area administered by Avon Health Authority.

1.2 Aims of the study

The study's aims were:

1. To evaluate an oral health care education programme for nursing home care assistants.
2. To evaluate the costs of providing the health education programme.

The objectives of the study were:

1. To describe the pre-existing levels of nursing home clients' oral health status and of carers' oral health knowledge and attitudes.

2. To assess any changes in carers' performance of clients' oral health care following oral health education (OHE).
3. To assess any changes in care assistants' knowledge of oral health care following OHE.
4. To assess any change in carers' attitudes towards oral health and oral health care following OHE.
5. To assess the costs of the intervention from the point of view of the NHS provider.

These aims and objectives were based on recommendations made by Eadie & Schou (1992) that carers be encouraged to 'reconsider the importance they attach to oral hygiene and to provide them with the necessary technical skills and knowledge to introduce the issue to the patient and to clean the patient's teeth, gums and dentures.' They also accorded with recommendations of (i) the United States Surgeon General (1988), that educational programmes for oral health care providers should improve their knowledge, attitudes and behaviours regarding primary preventive treatment and (ii) Burgio & Burgio (1990), that training of auxiliary staff should be accompanied by knowledge assessment and evaluation of skill performance in the clinical setting.

1.3 Outline of the thesis

The contents of the remaining chapters of this thesis are outlined as follows:

Chapter 2 reviews the literature on the expanding population of elderly people in the UK and the oral health problems experienced by the most functionally dependent of these individuals. The review focuses on the demographic changes that have occurred during this century, the medical and social conditions causing functional dependency, and the oral conditions to which elderly people are most susceptible. The impact of oral disease on psycho-social and general health and well-being is discussed. The barriers to oral health maintenance among elderly people are compared to the

additional barriers to oral health care encountered in nursing homes. Finally, the results of intervention studies aimed at improving carers' delivery of oral health care are reviewed. The conclusions drawn from these studies lead to the design of the present study.

Chapter 3 describes the design and conduct of the study. Details are given of clinical examination and scoring methods for assessing client oral health outcome measures, and of data collection methods for obtaining information on carers' oral health knowledge and attitudes. Methods of statistical analysis are also outlined.

Chapter 4 reports the study results from the client sample. Data from the control and intervention groups are compared at baseline. This is followed by a descriptive analysis of clients' oral health status at the three time points during the trial. Next, analysis of the efficacy of the intervention is made, with a final analysis taking account of cluster randomisation.

Chapter 5 reports the results of analysing responses to the carers' knowledge and attitude questionnaire. Data from the control and intervention groups are compared at baseline. Differences between responses from the two groups are then analysed, and composite knowledge and attitudes scores compared. Qualitative data obtained from open-ended questions are summarised. Finally, assessments of the oral health education sessions by presenter and participants are reported, together with an evaluation of the costs of the intervention.

Chapter 6 discusses the choice of study design and outcome measures, together with any issues arising from them. Following this, the analyses of data from the client sample and the carer sample are discussed, the findings are interpreted and the mechanisms behind any observed changes in oral health status, knowledge and attitudes are deduced. The inferences drawn from this study are compared with the conclusions of other researchers.

Chapter 7 summarises the results of the study in the light of current research. The implications of the findings for training and oral health care performance in nursing homes are discussed. Recommendations are made for further research in this area of interest.

Chapter 2

LITERATURE REVIEW

2.1 Background to the literature review

> 'The aim of modern medicine is not solely to prolong life for a greater number of people but to improve the quality of living so that more people are maintained in the best possible state of health and social independence in old age. The implication of this statement is that the state of oral health and standard of dental appliances worn should be as good as possible.'
>
> Ritchie (1973)

Twenty-five years ago, when Ritchie (1973) wrote those words, the medical and dental professions were just beginning to appreciate the remarkable changes in demography and health that have taken place in the UK in the course of the twentieth century. Progressive improvements in economic status and public health care together with advances in medical care have produced a dramatic reduction in both birth rates and mortality. Consequently, the proportion of the population reaching old age has risen steadily (Office for National Statistics, 1998). Since the inception of the National Health Service, more widely accessible dental treatment, together with advances in operative techniques, have resulted in a greater proportion of elderly people retaining some natural teeth.

Unfortunately, elderly people do not always enjoy the best state of oral health to which Ritchie (1973) aspired on their behalf. The majority of oral problems they experience are caused by preventable diseases rather than by the ageing process alone. While they are still fit and healthy, they are usually able to maintain their oral health. However, as disease or disability become more likely in later decades of life, more severely impaired individuals may become dependent on care-givers to assist with the tasks of everyday living, including oral health care. When family or friends cannot offer an adequate level of care, professional carers customarily look after individuals, either in their own homes, or in cases of greatest dependency, in formal care settings such as nursing homes. Regrettably, in institutionalised settings, where total care of clients is assumed to be provided, reports of oral health neglect are numerous. Studies which highlight these deficiencies include Manderson & Ettinger (1975), Gannon &

Kadezabek (1980), Empey *et al.* (1983), MacEntee *et al.* (1985), Schou *et al.* (1987), Hoad-Reddick *et al.*(1990), Hoad-Reddick (1991) and Merelie & Heyman (1992).

Oral health maintenance should be part of routine personal hygiene care in nursing homes. Satisfactory oral health is important not only for the comfort and well-being of clients, but also to prevent unnecessary deterioration of their vulnerable health status. Oral disease can affect general health (Limeback, 1988), while systemic diseases can have a marked effect on oral health and function (Shay & Ship, 1995). As increasing proportions of nursing home clients are likely to be dentate in future decades, the potential for oral and general health problems arising from dental diseases, particularly those related to plaque and oral hygiene, will assume greater importance.

This literature review will first cover the factors accounting for the growing population of functionally dependent elderly people in the United Kingdom. It will then consider the impact of oral health on the overall health and well-being of elderly people, especially those whose independence has been compromised. Next, factors affecting quality of care in nursing homes will be discussed, with particular reference to oral health care provision. Finally, the interventions of other researchers in attempting to improve oral health care in institutionalised settings will be reviewed, and their recommendations for further studies will be considered.

2.1.1 Literature search strategy

With the advice and assistance of the University of Bristol Dental Librarian, the electronic databases Medline, Embase and the Citation Index for Nursing and Allied Health Literature (CINAHL) were searched for this review. Each concept was entered and automatically mapped by the database programme. Each appropriate medical subject heading (MeSH) was exploded and keywords searched for in titles, abstracts and sub-headings in order to find related papers. The most useful terms were combined to form a set of search terms. Sets of search terms were compiled for subjects related to oral health (including oral health education), and for dental care for dependent elderly people. Terms in the oral health set were 'oral health', 'oral hygiene', 'health education, dental', 'oral health promotion', 'health behaviour' or

'public health dentistry'. Terms in the dental care set were 'dental care for aged', 'dental care', 'dental health services', 'dental health surveys', 'nursing homes', 'homes for the aged', 'caregivers' or 'nurses' aides'. The sets were combined to form a search strategy, which was then limited to 'aged 65 and over'. The time period covered by the searches was from 1975 onwards, except for Embase, which was from 1980 to the present day.

In addition, hand searching was carried out in books, papers and relevant journals including Gerodontology, Community Dentistry and Oral Epidemiology, Special Care in Dentistry, Community Dental Health, Journal of Public Health Dentistry, Health Education Journal and Health Education Quarterly.

2.2 The growing population of functionally dependent elderly people in the United Kingdom

The increasing size of elderly populations in the developed world is now well appreciated, and the causes of this demographic change will be discussed. National statistics show the elderly to be high consumers of health care. This is particularly in evidence during later decades of life, when the accumulation of age-related diseases has its most marked effect on functional ability. A small proportion of older age groups may become incapable of independent living. Some may need professional care, such as the services of a nursing home, in order to receive the basic daily care they require. The general health factors and social factors that influence the decision to admit an individual to a formal care setting will be considered.

2.2.1 The changing demography of the United Kingdom

During this century, the UK population has increased by half, from 38.2 million in 1900 to 58.8 million in 1996 (Office for National Statistics, 1998). The population profile has changed from an almost pyramidal shape, with a broad base of young

people and diminishing numbers of older people, to a more rectangular structure with similar numbers of young people but a greatly increased proportion of elderly individuals (Walls & Barnes, 1988). This trend characteristically accompanies urbanisation and industrialisation, and can be seen throughout the developed world (Locker, 1989).

This demographic change is the result of substantial improvements in economic status, social environment and health care, which have combined to reduce dramatically premature mortality from infectious diseases and to improve survival rates from potentially fatal diseases such as myocardial infarction, cerebrovascular accidents and some malignancies. Consequently, mean life expectancy at birth has risen from 46 years (male) or 49 years (female) in 1901 to 74.3 years and 78.9 years respectively today. The proportion of people over 65 will have risen from 4.5% in 1901 to an estimated 19% by 2021 (Office for National Statistics, 1998). The fastest growing segment of the population is the 'old elderly' over 75 years of age. Their current total of 3.95 million is nine times the total for the same age group (437,000) in 1901 (Central Statistical Office, 1993).

2.2.2 Implications for health care funding

The changing age structure of the population has important implications for health funding (Office for National Statistics, 1998). Stresses on services for people aged over 65 arise because, once retired, individuals are no longer economically productive, yet have high needs for medical and social care in the last years of life (Locker, 1989). At the same time, the proportion of the population contributing taxes to fund health services is diminishing (Office for National Statistics, 1997). Most deaths occur over the age of 75, preceded by a period of high dependency (Isaacs *et al.*, 1971; Coni *et al.*, 1993). For the majority of elderly, it is likely that brief or longer admission to a nursing home at some stage during that time will become necessary. Nursing home care is expensive and much of the cost is borne by the state in the form of income support (Todd, 1990). When oral health care of institutionalised individuals is neglected (Vigild, 1987, 1988, 1989; Ekelund, 1989, 1991; Merelie & Heyman, 1992), the costs of treating the resulting dental disease, often on a domiciliary basis, in

this ever growing population will impose further financial burdens on individuals and on the state.

2.3 How functional dependency and the need for formal care arise

2.3.1 General health factors

The current population of adults aged 65 and over shows great heterogeneity. The 65-75 year age group, often called 'young elderly', tend to resemble younger cohorts in their independent life-style. However, with all forms of natural life, maturity is followed by a steady decline in body efficiency. The cumulative effects of cellular ageing will eventually cause a physiological decline, which occurs with time in most organs, resulting in reduced capacity and reduced ability to meet challenges (Viidik, 1996).

This decline is so widely perceived and expected that all functional deterioration tends to be attributed to biological ageing. However, appreciable impairment of function is more frequently attributable to disease. As individuals age, they are more likely to suffer from disease or disability. There seems to be a watershed around the age of 75, after which elderly people are more vulnerable to the effects of illness, injury and medication (Resnick & Feigenbaum, 1992).

Diseases with greatest impact are those affecting the individual's capacity for independent living. Less incapacitated people notice difficulty with instrumental activities of daily living (IADL), such as climbing stairs or cooking. More disabled individuals have difficulty with the most basic activities of daily living (ADL), such as walking, bathing (which must include oral hygiene), feeding, toileting and dressing (Resnick & Feigenbaum, 1992).

Some diseases which impair the physical activity necessary to accomplish ADL are also among the commonest causes of death in older people, notably cardiovascular disease, cerebrovascular disease and respiratory disease (Office for National Statistics, 1997). The incidence of malignancies is age-related, with over half of all cancers in the developed world occurring in those aged over 65 (Coni *et al.*, 1993). Other physically limiting diseases common in the elderly affect the musculoskeletal system (e.g. osteoporosis, rheumatoid and osteo-arthritis), endocrine system (e.g. diabetes), and central nervous system disease (e.g. Parkinsonism) (Resnick & Feigenbaum, 1992; McCusker *et al.*, 1996). Activity can also be limited by mental disorders such as depression, confusion and dementia, which are frequently found in the elderly, both as primary disease or secondary to medication or coexisting illnesses (McCusker *et al.*, 1996).

In old people, illness often presents atypically and non-specifically. Multiple pathology is common, and multiple aetiological processes tend to converge on the most vulnerable physiological systems. Thus, no matter what the underlying disease, certain presenting symptoms predominate, namely acute confusion, depression, falling, syncope and incontinence (Resnick & Feigenbaum, 1992; Coni *et al.*, 1993). These symptoms are among the main reasons for elderly people becoming functionally dependent and being admitted to formal care (Isaacs *et al.*, 1971).

2.3.2 Social factors

Although the majority of people aged over 65 are fit and healthy enough to look after themselves in their own homes, some are housebound, needing assistance with IADL, either from a spouse, family members or social services staff. When help is required with at least one ADL, the elderly person may still be able to live at home, if sufficient suitable carers are available, but is increasingly likely to need institutional care (Coni *et al.*, 1993).

In the form of residential and nursing homes, institutional care is largely a phenomenon of the developed world, reflecting the massive social changes that have occurred this century. Whereas a hundred years ago, different generations lived in large extended families where younger members were able to look after the old and the sick, today's family size is markedly smaller. The number of 'traditional' households, consisting of a married couple with one or two children, now accounts for only 20% of homes, while among those under pensionable age, the proportion of single person households had trebled from 4% in 1961 to 12% in 1991 (Office for National Statistics, 1998). Fewer family carers are available, since more women work outside the home. The 'children' of octo- and nonagenarians are themselves elderly and limited in the support they can give. Thus practical difficulties supervene at the level required for care of an elderly relative (Boyd, 1981; Walls & Barnes, 1988).

Bedridden and housebound people represent around 12-14% of the total population over 65 years old in Northern Europe. Between a third and a half of these individuals live in institutions (Christensen, 1988). In a study in Scotland, Isaacs *et al.* (1971) found that most institutionalised patients came from the oldest stratum of society and represented 'the survival of the unfittest'. More than 60% of them had lost their independence because of immobility, incontinence and intellectual impairment. More recently, instability and iatrogenic drug reactions have been added to this list (Resnick & Feigenbaum, 1992). Other authors (Coni *et al.*, 1993; Strayer, 1993; Ettinger, 1996) have observed that individuals at greater risk of institutionalisation share certain characteristics. Most of them are aged over 80, female and living alone with no close relatives. Almost all are disabled by poor physical health and take multiple medications. Less than 50% are ambulant. They are likely to have fallen several times and/or to be depressed, intellectually impaired or incontinent. Once admitted to a nursing home, few will leave before they die. Although only 4% of the elderly UK population live in institutions (Coni *et al.*, 1993), they have extensive care needs. Typically, they need help with personal hygiene, dressing and, if ambulant, assistance when walking. With care needs of such a basic kind, help with oral hygiene is likely to be a common requirement, albeit a largely unrecognised one among institutionalised elderly people (Ekelund, 1988; Miyazaki *et al.*, 1992; Knabe & Kram, 1997).

2.4 Oral health in elderly people

In Section 2.4, the literature on oral health in elderly people and its influence on general health and well-being will be reviewed.

While some treatment needs in the elderly arise from age-related changes in oral tissues, the majority arise from largely preventable dental disease processes. Falling levels of edentulousness in successive cohorts of elderly people are likely to change the pattern of future dental care provision for this age group. The role of plaque in the oral health of both dentate and edentate elderly will be considered. From the diverse body of literature on this broad subject, the conditions most commonly affecting elderly people and most closely related to this study's outcome measures have been selected. These conditions are denture-induced stomatitis, gingivitis, periodontal disease and caries. Xerostomia will also be considered, since it may increase a subject's susceptibility to the other conditions under review. The epidemiology and risk factors of the conditions will be reviewed. The literature indicates that elderly people may be at an increased risk from these conditions, and that the risk is higher for people living in institutions. The special importance of oral disease for functionally dependent people in nursing homes will be discussed, both in relation to subjects' quality of life and to their overall health. Systemic disease and medication may affect the health and function of the mouth, while recent research indicates that oral diseases may be significantly implicated in the development of systemic disease. Additionally, oral problems can impact on social and psychological well-being.

The barriers to elderly people's oral health maintenance will be studied, including levels of oral health knowledge, dexterity and psychological factors. Finally, factors contributing to their low utilisation of dental services will be considered.

2.4.1 Oral health status of the elderly population

In his historical review of the dental health status of populations, Burt (1978) noted that caries became highly prevalent in the UK during the second half of the nineteenth

century and remained so until the 1940s. Until that time, extraction was the dental treatment of choice, fuelled by the then popular theory of focal infection. Many people lost their teeth during this period, as they did during the first four years of the National Health Service, largely as a result of the enormous backlog of neglect. Edentates from that period now form a substantial part of the elderly population.

Locker (1989) observed how new developments in equipment and materials, economic incentives for dentists to prevent tooth loss, and changes in attitude and affluence levels have led to more teeth being restored. Between 1950 and 1980, the number of teeth extracted fell by 40%. Data from the 1988 Adult Dental Health Survey (Todd & Lader, 1991) showed that between 1968 and 1988, there has been a reduction in edentulousness in the 65-74 age group of 22% (to 57%) and of 8% (to 80%) in those aged over 75. These changes are due mainly to cohort differences between generations with differing social and historical experiences (Locker, 1989).

With increasing numbers of dentate individuals, caries and periodontal disease will assume greater importance in dental care provision. Todd & Lader (1991) recorded that, among subjects aged 65 and over, 47% of dentate adults had untreated caries and 97% had two or more sextants of the mouth affected by some form of periodontal disease. Currently in the UK, only 19% of all 65-74 year-olds and 7% of all those aged over 75 attend for regular dental examinations, although attendance rates for dentate subjects in these two age groups are higher at 44% and 38% respectively (Todd & Lader, 1991). Locker (1989) believed that caries and periodontal disease among the elderly were likely to remain significant public health problems, and that demand for treatment of these conditions would rise as cohorts with greater expectations reached old age.

2.4.2 The role of plaque and oral hygiene in oral health

Dental plaque in man arises from intrinsic oral bacteria, which proliferate and adhere to tooth surfaces. This bacterial plaque is one of the essential factors in the pathogenesis of dental caries (Theilade & Theilade, 1976), and is the major aetiological factor in chronic gingivitis (Löe *et al.*, 1965). Subgingival plaque is

strongly associated with the advancing lesions of periodontal disease (Theilade & Theilade, 1976; Abdellatif & Burt, 1987) and advanced periodontitis (Slots, 1977). Among denture wearers, *Candida albicans*, deriving from plaque accumulation on denture surfaces, is the principal aetiological factor in denture-induced stomatitis (Budtz-Jørgensen, 1978). Effective removal of plaque from teeth and dentures at least once a day is generally accepted as an important method of reducing the risk of all of these diseases (Levine, 1996). However, as the literature reviewed below reveals, elderly people may be predisposed to accumulating greater amounts of plaque than younger age groups, while being less effective at removing it from teeth and dentures.

2.4.3 Common oral conditions observed in elderly people

2.4.3.1 Denture-induced stomatitis and poor denture hygiene

With 67% of people aged over 65 in the UK currently edentulous and likely to be wearing at least one complete denture, and a further 23% wearing partial dentures (Todd & Lader, 1991), potentially the most common disease from which this age group is at risk is denture-induced stomatitis. Classification of this condition recognises three types (Newton, 1962; Budtz-Jørgensen, 1978). Type 1 shows localised or pin-point hyperaemia and is mainly due to denture trauma. Type 2 (diffuse erythema) and type 3 (inflammatory papillary hyperplasia) are associated with candidal and/or bacterial infection caused by contamination of the fitting surface of dentures by plaque. While wearing dentures at night, eating a high-carbohydrate diet, anaemia, host susceptibility or broad-spectrum antibiotic therapy may increase susceptibility to palatal candidosis, there is more reliable evidence that poor denture hygiene is the significant predisposing factor (Budtz-Jørgensen, 1978; Cardash *et al.*, 1989; Jeganathan *et al.*, 1997).

Reviewing evidence about denture-induced stomatitis, Arendorf & Walker (1987) observed that researchers had found higher *Candida* levels in affected subjects. *Candida albicans* is not universally carried in the oral flora; the prevalence of oral carriers appears to vary according to whether or not a denture is worn. Arendorf &

Walker (1979) found that the frequency of *C. albicans* carriers rose from 44% in healthy dentate subjects to 71% in a sample of denture wearers (comprising 34 out of 60 healthy denture wearers and all 30 subjects with denture-induced stomatitis). These findings suggested to Arendorf & Walker (1979) that, while some dentate non-carriers may be resistant to mucosal colonisation by *C. albicans*, the bacterial plaque that forms on the fitting surface of a denture may encourage the adherence and establishment of candidal colonies. The highest levels of *Candida* are usually found on the denture base, which appears to act as an applicator to the palatal mucosa. Tarbet (1982) found a significant correlation between denture plaque levels and palatal erythema scores, and between candidal count and erythema scores, although not between plaque levels and *Candida* counts on the palatal mucosa. This suggested that plaque and *Candida* independently affected palatal mucosa. More recently, Blair *et al.* (1995) have shown a strong positive correlation between stomatitis levels and counts of anaerobic and aerobic organisms, which form the bulk of denture plaque.

The consensus of opinion is that, in the absence of systemic involvement, mechanical removal of plaque is sufficient to treat the condition and prevent its recurrence, although in persistent cases, antimycotic drugs may be necessary (Budtz-Jørgensen, 1978; Tarbet, 1982; Arendorf & Walker, 1987). Budtz-Jørgensen & Löe (1972) also showed disinfection of dentures by chlorhexidine solution to be an effective treatment. For routine cleaning, Collis & Stafford (1994) believe there may also be a place for chemical denture cleansers, where patients find meticulous brushing difficult, although the most popular alkaline peroxide cleanser has been shown to be less effective than hypochlorite, acidic or abrasive cleansers. Despite lay perceptions of the sterilising properties of many popular proprietary denture cleansers, DePaola *et al.* (1984) found that these solutions were heavily contaminated with and permitted the growth of pathogenic organisms deriving from dentures, thus posing a potential risk to immunocompromised patients.

Studies of denture-induced stomatitis in populations have found widely differing disease levels of 11-67% (Arendorf & Walker, 1987), which may indicate either true differences in the subjects selected for study or inter-examiner variability. Among

institutionalised samples, denture-induced stomatitis levels between 19% and 52% have been recorded (Ritchie, 1973; Schou *et al.*, 1987; Vigild, 1987; Hoyen-Chung, 1989; Pietrokovski *et al.*, 1990a; Jorge *et al.*, 1991; Wilkieson *et al.*, 1991; Merelie & Heyman, 1992; Jokstad *et al.*, 1996; Knabe & Kram, 1997). The majority of these studies also commented on the poor levels of denture hygiene among institutionalised elderly individuals. Even among less disabled community-dwelling elderly, Smith & Sheiham (1979) found 51% with inadequate denture hygiene.

Researchers have identified several reasons for poor denture hygiene in institutional settings. Ekelund (1988) found that not all clients who claimed to be able to brush their dentures actually did so, and even when clients claimed to brush, two-thirds of dentures were unclean. Schou *et al.* (1987) concluded that denture brushing by elderly people has no apparent effect on denture plaque levels. Studies by Stuck *et al.* (1989) and Merelie & Heyman (1992) showed that, even when staff assistance was available, dentures cleaned by staff were no cleaner than those cleaned by clients. These findings were corroborated by Knabe & Kram (1997) who noted that when staff cleaned dentures, they did not use a brush. Wilkieson *et al.* (1991) also reported that staff did not brush dentures, merely soaking them in ineffective alkaline peroxide solution. Pietrokovski *et al.* (1990a) found that staff and relatives were willing to help residents with personal hygiene, but were reluctant to remove dentures or brush them. Regrettably, the dentures of nursing home clients have been shown to be dirtier than those of any other groups of elderly people dwelling in the community or in long-stay hospitals (Hoad-Reddick *et al.*, 1990). There has also been a reported increase in mucosal lesions once individuals are reliant on staff for denture hygiene (Pietrokovski *et al.*, 1995).

2.4.3.2 Gingivitis and periodontal disease

Both gingivitis and periodontal disease are characterised by inflammation. Inflamed gingivae are red, swollen and tend to bleed on probing. The inflammatory process may spread until there is loss of periodontal attachment and alveolar bone, leading to gingival recession or deepened periodontal pockets. Symptoms of early disease are

mild and frequently deemed insignificant by patients. In advanced periodontitis, there may be increased tooth mobility (Holm-Pedersen, 1996).

With an increasing elderly population and an increased rate of tooth retention, more teeth are likely to be at risk of periodontal disease. However, periodontitis is not a natural consequence of ageing. Johnson *et al.* (1989) and Burt (1994), reviewing periodontal studies over the last 50 years, pointed out the need to distinguish age-related changes (which by themselves are clinically insignificant) with periodontal disease, which is caused by bacteria and mediated by host response. The consensus of current opinion is that the disease may exist in several forms in different races and age groups, with the majority of disease clustered in a minority of people. The disease process may not be continual, but may occur episodically within individuals. While significant destruction may occur in some sites at certain times, the majority of sites remain stable. Thus, apparent epidemiological increases in periodontal disease with age usually represent the cumulative effect of change during a subject's lifetime. Katz *et al.* (1996), reviewing research on risk factors for periodontal disease, reported that while age, sex and tobacco use have all been cited, their effects are negligible when analysis is controlled for oral hygiene. Abdellatif & Burt (1987) considered that oral hygiene was the most important predictor for periodontitis, the prevalence within any age group being at least eight times higher among those with poor oral hygiene.

Löe *et al.* (1965) found that bacterial plaque was essential in the production of gingival inflammation. In the absence of oral hygiene, gingivitis developed in 10-21 days, and was associated with significant microbiological changes in the ageing plaque. Gingivitis regressed completely on reinstatement of oral hygiene measures. Elderly people are at considerably higher risk of gingivitis than younger age groups. Holm-Pedersen *et al.* (1975) found that, during oral hygiene abstention, gingivitis developed considerably more rapidly and more severely in subjects aged over 65 than among 20-24 year old subjects. The former group had markedly higher crevicular exudate levels and showed slower recovery of gingival tissues when oral hygiene was resumed.

Several factors have been implicated in elderly people's greater susceptibility to inflammation of periodontal tissues. Holm-Pedersen *et al.* (1975) noted that, during abstinence from oral hygiene measures, plaque accumulation and calculus formation were greater in a sample of elderly individuals than in a sample of young adults. The authors believed that this effect might be due to gingival recession in the elderly group resulting in exposure of larger areas of tooth surface and cementum, on which plaque could form more easily. They postulated that dietary differences, altered composition of plaque or saliva, or age-related decline in immune response to plaque micro-organisms might affect susceptibility.

However, not all elderly people run an equal risk of periodontal disease. Although Smith & Sheiham (1979) found high levels of intense gingivitis in 57% of a sample of independent elderly people, epidemiological studies conducted on frail, institutionalised or over 85 year old subjects have found them to be at even greater risk from poor oral hygiene and poor periodontal health (Ambjørnsen, 1986; Strayer & Ibrahim, 1991). Probably the most comprehensive study of periodontal disease among institutionalised elderly (Vigild, 1988) compared samples in nursing homes and in hospital long-term care (LTC) in Denmark. In both groups, two-thirds had abundant plaque and one quarter had severe gingivitis with spontaneous bleeding. Both these parameters were worse among patients who received staff assistance in brushing. Overall, nursing home clients had worse oral health than hospitalised patients. Abundant calculus was found in 35% of nursing home clients, compared to 17% in LTC, while the figures for pocketing in excess of 4mm were 77% and 56% respectively. Other studies of institutionalised populations in Europe, the USA and Japan have corroborated Vigild's (1988) findings. Periodontal treatment needs, approximately half of them for severe periodontitis, have been identified in 72-90% of residents (Wilson *et al.*, 1987; Stuck *et al.*, 1989; Strayer & Ibrahim, 1991; Kiyak *et al.*, 1993). Bleeding on probing was recorded in 25% of teeth examined by Jokstad *et al.* (1996). Ekelund (1988) found that 97% of residents had plaque affecting 93% of all teeth. Similarly low oral hygiene levels were found in 80-98% of dentate residents by Hoyen-Chung (1989), Miyazaki *et al.* (1992), Jokstad *et al.* (1996) and Knabe &

Kram (1997). Even among residents claiming to brush daily, more than 75% had unsatisfactory oral hygiene (Ekelund, 1988; Mersel, 1989).

The body of evidence suggests that nursing home clients have poorer oral hygiene and more severe periodontal conditions than community-dwelling elderly. Possible reasons for this trend will be discussed later in Section 2.5.2.

2.4.3.3 Dental caries

With the marked decline in edentulousness among the elderly aged 65-75, there has been a wave of epidemiological studies during the last decade on dental caries in older adults. In a review of these studies, which show greater breadth and consistency than earlier studies, Katz *et al.* (1996) noted that although there is a trend for decayed, missing and filled teeth scores (DMFT) to fall in all age groups, there are signs that the yearly increment of caries in older adults is equal to or greater than the annual caries increment for children in the USA in the 1970s, that is, prior to the 30-40% caries reduction seen at that time in industrialised countries. This level of caries is considered a high rate, although most lay people do not perceive caries to be a problem for the elderly.

However, the elderly may be especially susceptible to caries. A fifteen year longitudinal study by Axelsson *et al.* (1991) showed that, even under a strictly supervised preventive regimen, a higher proportion of individuals aged over 50 experienced coronal caries than did any other age group. Reviewing root caries susceptibility, Katz (1980) noted reports of a six-fold increase in prevalence between individuals aged under 30 and those aged over 60.

Many risk factors for root caries have been identified. Those which have been identified in meta-analysis as statistically significant in both prevalence and incidence studies include increased age, institutionalisation, high lactobacillus counts, poor oral hygiene with visible plaque on teeth, gingivitis, loss of periodontal attachment, previous root caries experience, few remaining teeth and periodontal pockets greater than 3mm (Galan & Lynch, 1993). Other predictors of root caries include calculus,

frequent carbohydrate intake, high salivary *Streptococcus mutans* counts and xerostomia. The most frequently affected sites are mandibular teeth, especially molars and premolars, and buccal surfaces (Kitamura *et al.,* 1986; Kidd, 1989; Galan & Lynch, 1994; Budtz-Jørgensen *et al.*, 1996).

In healthy, independent adults, reports of root caries prevalence rates mostly fall in the 50% range (Katz *et al.*, 1996). In studies confined to elderly independent adults, prevalence rates of 52-78% have been reported (MacEntee *et al.*, 1988; Wallace *et al.*, 1988; Locker & Leake, 1993; Strayer, 1993; Joshi *et al.*, 1994; Steele *et al.*, 1996). Among the institutionalised and chronically ill, still higher prevalence rates of 54-89% have been reported (Banting *et al.,* 1980; Vigild, 1989; Angelillo *et al.*, 1990; Strayer & Ibrahim, 1991; Budtz-Jørgensen *et al.*, 1996; Jokstad *et al.*, 1996).

A recurrent theme emerging from studies of institutionalised elderly is that institutionalisation itself is a significant predictor of root caries, especially when cognition is impaired. The risk of root caries is around three times greater in institutionalised people than in independent elderly (Kitamura *et al.*, 1986; MacEntee, 1994) and almost eight times greater among demented patients (Jones *et al.*, 1993). However, high plaque levels were also found in these studies, so it may be that institutionalisation is a predictor of plaque, which in turn is a predictor of root caries. These and other studies of root caries predictors are summarised in Table 2.1.

A positive correlation between root caries prevalence and functional dependency has been identified by Vigild (1989) and Galan & Lynch (1994), although Budtz-Jørgensen *et al.* (1996) were surprised not to find a similar association in their study among Danish hospitalised elderly subjects. A link between root caries and functional ability appears plausible. Control of plaque, one of the significant risk factors for root caries, requires good manual dexterity (Felder *et al.*, 1994a, 1994b). However, manual dexterity is likely to be poor among institutionalised clients and, as Ostwald *et al.* (1989) discovered, has proved a significant predictor of admission to nursing homes. In the light of this finding, it is not surprising that Kambhu & Levy (1993) observed that over half the dentate subjects in an institutionalised sample in the USA needed direct assistance with tooth-brushing.

Table 2.1: Predictors of root caries in the institutionalised elderly

Authors and year	Location	Study population	Predictors of root caries	
Banting *et al.* (1980)	Canada	59 long-term care patients	♦Older age ♦Gingival recession ♦Proximal/buccal surfaces ♦Anterior teeth	♦Fewer retained teeth ♦Number of retained roots ♦Coronal caries experience
Kitamura *et al.* (1986)	USA	23 nursing home residents 24 independent elderly	♦Institutionalisation [2.5 x increased risk] ♦Gingival recession ♦Calculus ♦Plaque	♦Fewer retained teeth ♦Mandibular posterior teeth ♦Buccal surfaces ♦Xerostomic drugs
Vigild (1989)	Denmark	126 nursing home residents 75 long-term care patients	♦Older age ♦Degree of helplessness ♦Low utilisation of dental services	
Jones *et al.* (1993)	USA	Alzheimer's nursing home patients Independent elderly	♦Alzheimer's disease [7.7 x increased risk]	
MacEntee *et al.* (1993)	Canada	Nursing home residents Independent elderly	♦Institutionalisation [3.3 x increased risk] ♦Poor oral hygiene	♦High lactobacillus counts ♦Frequent sugar consumption
Budtz-Jørgensen *et al.* (1996)	Switzerland	120 hospitalised elderly	♦Institutionalisation ♦Infrequent oral hygiene ♦Psychiatric disorder	♦Gender [male] ♦High buccal/mesial plaque ♦Coronal/recurrent caries experience

Fortunately, there is evidence that preventive dental therapies can be effective at reducing root caries initiation, even among individuals most at risk (MacEntee, 1994; Budtz-Jørgensen *et al.*, 1996; Katz *et al.*, 1996). Raising awareness of the value of prevention among elderly people and formal carers may help to bring about reductions in root caries incidence in the future.

2.4.3.4 Xerostomia

Many elderly people suffer from the subjective symptom of oral dryness (xerostomia), which is commonly associated with salivary gland dysfunction, but can also occur when the glands are functioning normally. Not only may xerostomia be symptomatic of systemic disease, it also has important implications for the subject's quality of life and dental management. Saliva has important protective functions in lubricating the oral mucosa, buffering the acidogenic effects of cariogenic bacteria, remineralising teeth and protecting the host against microbiological infections. Saliva is also important in facilitating mastication, swallowing and the sense of taste (Fox *et al.*, 1985; Shay & Ship, 1995; Baum, 1996). In the presence of diminished salivary flow, the adherence and abundance of plaque increases. Thus, while xerostomia is not one of the conditions preventable by good oral hygiene, it makes the performance of regular and effective plaque removal especially important.

It has been known for some time that in healthy adults, the secretory reserve of the major salivary glands is usually sufficient to compensate for the age-related loss of up to 50% of acinar tissue (Drummond *et al.*, 1988), and there does not appear to be any significant alteration in salivary composition in elderly people (Baum, 1996). Diminished salivary output therefore is more likely to be caused by systemic diseases and their associated medications. In industrialised countries, elderly people consume a disproportionate amount of pharmaceutical drugs. Many of these drugs affect salivary flow, most commonly antidepressants, anxiolytics, diuretics, antihypertensive, anticholinergic and antihistaminic drugs. Another common cause of xerostomia is oncological therapy. Both cytotoxic or immunomodulatory chemotherapy for any form of cancer and radiotherapy of head and neck malignancies (90% of which occur

in individuals aged over 50) destroy salivary gland tissue, with acinar glands being especially susceptible. Lastly, the autoimmune exocrinopathy, Sjörgren's syndrome, causes destruction of acinar tissue (Shay & Ship, 1995; Baum, 1996).

All the major physiological functions for saliva can be compromised by its hyposecretion, regardless of aetiology. From a symptomatic aspect, patients are aware of discomfort and inconvenience when speaking and eating (Fox *et al.*, 1985). From a therapeutic viewpoint, the antimicrobial, buffering and diluting properties of saliva are diminished. As a result, plaque will become thicker and more adherent, increasing the risk of periodontal disease and root caries; the dehydrated mucosa will become more susceptible to infections; lack of saliva may also increase the risk of aspiration pneumonia due to impaired swallowing (Shay & Ship, 1995; Katz *et al.*,1996).

All the above sequelae of xerostomia are potentially more threatening to nursing home clients, who are likely to be frail and to have several disabilities. Not only will their quality of life be further compromised, but those who are unable to eat or to carry out oral hygiene unaided will be at particular risk unless their carers are motivated and competent enough to provide effective assistance.

2.4.4 The importance of oral health in elderly people

The two most obvious functions of the mouth, eating and speaking, are not only essential to normal life, but can also be the source of great pleasure. The third major function of the mouth is that of host protection. The airway and alimentary tract are protected by salivary secretions and the effective functioning of the swallowing mechanism. Oral function is therefore intimately connected to health, well-being and quality of life and, as Shay & Ship (1995) observed, is particularly important in elderly people, who may be predisposed to malnutrition, reliant on social contacts and susceptible to infection.

2.4.4.1 The impact of oral disease on quality of life

The high prevalence of dental disease throughout the world has implications for social and psychological health as well as physical health. Perhaps because dental disease is not life-threatening or seriously impairing for most people, a sample of elderly subjects ranked oral care sixteenth out of seventeen health concerns (Thines *et al.*, 1987). Nonetheless, it may cause pain and discomfort, diminish an individual's enjoyment of life and lead to a negative self-image (Sheiham & Croog, 1981). It may also lead to social withdrawal, apathy and diminished functional status (Thines *et al.*, 1987). It has been found to have a greater impact on social functioning than gastrointestinal disorders, acute skin and eye complaints and headaches (Ettinger, 1987).

Pain and discomfort are probably the most important psychological experiences associated with oral disease. Dental pain may be sufficient to cause confusion and cognitive problems (Locker, 1989), and some perceive it as punishment from God (Sheiham & Croog, 1981). Locker (1992) found that 37% of older adults had suffered dental pain in the preceding month. Smith & Sheiham (1979) reported a similar percentage, of which 89% had suffered for over a month but only 17% had sought professional help.

Perhaps the greatest impact on self-esteem comes from loss of teeth. As Giddon (1964) observed, it may aggravate feelings of deterioration of body image associated with ageing. Other authors have associated tooth loss with depression, psychological trauma and loss of masticatory function (Sheiham & Croog, 1981; Ley & Langsjoen, 1985). It appears that edentulous persons are more likely to be dissatisfied with their oral condition than dentate individuals (Jokovic & Locker, 1997), and many displace their dissatisfaction of life in general on to their dentures (Albino, 1983). As long as at least one natural tooth remains, subjects are more likely to rate their oral health favourably (Berkey *et al.*, 1985). However, they may also have unpleasant memories of treatment. Around 50% of the UK population reported vivid, negative dental experiences associated with natural teeth; in older age groups, a higher proportion of those aged 55-64, from whose ranks the nursing home clients of 15-20 years time will

be drawn, had vivid memories (51% compared to around 40% of those aged 65 and over (Todd & Lader, 1991). Albino (1983) found that the presence of caries was not a worry for older age groups, but that periodontal treatment, often lengthy and uncomfortable, provoked not only concern, but also a sense of guilt that individuals had not cared sufficiently for their oral health.

In the social context, appearance, communication and eating ability significantly affect the enjoyment of life. Appearance of teeth was rated as very important by 77% of a sample of elderly UK subjects (Tobias & Smith, 1987). In a Canadian study (Jokovic & Locker, 1997), 22% of subjects were unhappy about the appearance of their teeth or dentures. In other surveys of elderly people in the USA, 46% reported embarrassment over unsightly natural teeth (Berkey *et al.*, 1985), 24% disliked the appearance of their dentures (Jokovic & Locker, 1997) and 15% felt their dental appearance had a negative effect on others (Strauss & Hunt, 1993). In Smith's (1979) UK study, 20% of elderly subjects were embarrassed by dentures dropping when talking, while 12% of Strauss & Hunt's (1993) sample expressed negative feelings about their ability to talk, laugh or smile. One third of elderly people studied by Locker (1992) reported problems with social interaction and communication, while a later survey (Jokovic & Locker, 1997) found that 4.2% of dentate and 11% of edentulous elderly felt they were unable to speak clearly. Sheiham (1990) observed that good oral health and freedom from halitosis will enhance elderly people's self-image and dignity.

Although Farrell (1956) showed that the degree of mastication did not seriously impair digestion of food, eating is important as a pleasurable and social function. Strauss & Hunt (1993) found that the top five positive and negative responses about the effect of teeth on quality of life involved chewing and enjoying food. Up to 11% of dentate individuals and 32% of edentulous people have reported difficulty or pain when chewing (Smith & Sheiham, 1979; Berkey *et al.*, 1985; Locker, 1992; Jokovic & Locker, 1997). The length of time needed to eat a meal was a sufficient embarrassment to 40% of elderly subjects surveyed by Smith & Sheiham (1979) that many tried to avoid eating in company and as a result suffered social isolation and depression.

Albino (1983) concluded that the most preventable dental conditions have the greatest potential for psychological effect, and that the psychological impact of dental disease is at its peak among elderly people, at a time in their lives when they can least well tolerate stress. Vigild (1993) suggested that, to improve quality of life, it was not necessary to treat all dental disease for frail, dependent elderly, but rather to take a more realistic approach, taking into account an individual's desire for and ability to undergo treatment of any particular condition.

2.4.4.2 The relationship of oral health to general health

Recent research has suggested that there may be a closer association between oral disease and certain systemic diseases than had formerly been appreciated. Systemic disease may predispose subjects to oral disease, as Shlossman *et al.* (1990) suggested regarding the association between diabetes and periodontal disease. Medication prescribed to treat systemic diseases may increase the risk of periodontal disease or gingival conditions. For example, Phenytoin, calcium channel blockers and cyclosporin may cause gingival enlargement, while xerostomic drugs increase plaque accumulation and reduce the rate of resolution of gingivitis following oral hygiene measures (Ciancio, 1996). Conversely, the pathogenic effects of oral micro-organisms, usually confined to the mouth, may spread to other organs by bacteraemia or aspiration.

Scannapieco & Mylotte (1996) speculated that the logical source of aspired bacteria causing bacterial pneumonia or lung abscesses is likely to be dental plaque, especially in patients with periodontal disease, where numbers of anaerobic bacteria are increased. The authors noted that institutionalised patients, who are at high risk of pneumonia, are likely to have neglected oral hygiene, which may promote oropharyngeal colonisation by potential respiratory pathogens. A longitudinal study of nursing home residents by Mojon *et al.* (1997) found that the incidence of respiratory tract infection (RTI) was greater among dentate subjects, especially those who had required emergency dental treatment during the study period. These subjects had higher plaque scores than those not experiencing RTI. Oral health problems and experience of RTI were clearly associated with poor general health, and the authors

concluded that poor oral hygiene could be a major risk factor for RTI among the frail elderly.

Circumstantial evidence is growing concerning the role of oral, particularly periodontal, disease in cardiovascular disease and other thrombo-embolic disorders. Mattila *et al.* (1989) conducted a case-control study which found that the total dental index (a composite score of different dental conditions) was significantly higher in myocardial infarction patients than in healthy controls. Although several cultural and lifestyle risk factors, including diet and exercise, were not included in the analysis, most other potential variables did not significantly contribute to the model. Further evidence of an association between dental disease and coronary heart disease (CHD) comes from two larger population studies. One study, in the USA, indicated that subjects with periodontitis had a 25% increased risk of CHD compared to those with a relatively healthy periodontium. Poor oral hygiene also increased the risk of CHD (DeStefano *et al.*, 1993). Another study in the USA (Beck *et al.*, 1996) followed a cohort of systemically healthy individuals as they aged over an 18 year period. A strong association between baseline periodontal bone loss and both fatal CHD and stroke was observed. A smaller cross-sectional study in the USA (Loesche *et al.*, 1998) identified several oral health variables as risk indicators for CHD, including having a few (1-14) teeth, low levels of *Streptococcus sanguis* (which is dominant in early plaque formation, and is therefore found at higher levels in subjects with good oral hygiene), and higher levels of types of anaerobic bacteria associated with periodontal pathology. The anaerobes concerned contain lipopolysaccharides, which have been implicated as possible promoters of atherosclerosis and thrombus formation.

Interestingly, research by DeStefano *et al.* (1993) suggested that edentates were at a similar risk of CHD as subjects with severe periodontitis, while McCord & Connolly (1997) found that edentulous patients were at greater risk, following hospitalisation, of complications such as stroke, RTI, confusion and functional dependency. Further research into subjects' past experience of dental disease may clarify the association of edentulousness with certain systemic diseases.

2.4.5 Barriers to maintaining oral health in elderly people

Individuals of all ages may experience barriers to achieving good oral health, but the literature on older people's oral status reveals a number of factors that particularly deter the elderly from carrying out adequate home care for their teeth and dentures or from seeking professional dental care.

2.4.5.1 Factors affecting the performance of oral hygiene

Optimal oral health in elderly people may be achieved in the same way as it may for younger age groups, by daily brushing with fluoride toothpaste, interdental cleaning, use of fluoride or antimicrobial mouthwashes, dental visits at least annually and a balanced dietary pattern (Gift, 1988). However, older age groups may never have been taught appropriate dental behaviours or may be acting on outdated advice. Love *et al.* (1967) and Bauman (1980) found that most denture wearers had received no instruction in home care for dentures, and few of those who received instructions were given written support advice. Among Merelie & Heyman's (1992) sample of institutionalised elderly, few remembered receiving advice on cleaning dentures (9%) or natural teeth (17%). Understandably, many elderly people do not realise what plaque is or why it should be removed adequately from their teeth (Wilson *et al.*, 1987; Ettinger, 1997).

Among elderly people cleaning their own dentures, cleanliness rates are low (Ritchie, 1973; Smith & Sheiham, 1979; Ekelund, 1988; Hoad-Reddick *et al.*, 1990; Merelie & Heyman, 1992). Collis & Stafford (1994) found that although most dental hospital out-patients were satisfied with their denture hygiene, a clinician rated 70% of dentures as unclean. The authors concluded that patients were apathetic and that their standards of denture hygiene were uncritical.

Among dentate subjects, low frequencies of brushing have been reported, decreasing with age, particularly among men (Lappalainen *et al.*, 1988; Mersel, 1989). Many individuals who claim to brush their teeth daily have high plaque levels (Ekelund, 1988; Søgaard *et al.*, 1991; Merelie & Heyman, 1992). In a Norwegian study, elderly

community-dwellers reported good oral hygiene habits, yet 65% of teeth had visible plaque (Ambjørnsen, 1986); the author suggested that elderly people believe they clean their teeth properly, but are unaware of the poor effect of their efforts.

For many old people, reduced dexterity and vision may be a problem. A US study showed that dexterity correlated significantly with plaque levels in an elderly sample, although it also seemed likely that erosion of oral care skills went unnoticed compared to declines in other self-care areas (Felder *et al.*, 1994a). In support of this theory, Smith & Sheiham (1979) noted that although 20% of their sample of older adults said that arthritis prevented them from moving their hands or fingers easily, only 9% felt that this impaired their ability to clean teeth or dentures. In Merelie & Heyman's (1992) study, a third of institutionalised subjects had difficulty using their hands, a quarter were blind or partially sighted, yet the majority tried to perform their own tooth and denture care.

Tooth- and denture-brushing is often perceived as a hygiene activity with social rather than health-related undertones (Sheiham, 1983; Freeman & Linden, 1995) and may thus be a sensitive issue. A group of elderly people in a study in Scotland reacted adversely to questions about their oral hygiene habits, regarding them as a personal routine which they performed sufficiently well, and about which they needed no further information (Schou & Eadie, 1991). In another sample of elderly in Essex, 90% thought oral hygiene was important but 70% believed they knew all they needed on the subject (Tobias & Smith, 1987).

Other factors identified as possible influences on elderly people's attitudes to regular oral hygiene include social class (Blaikie, 1979; Beal, 1983; Ambjørnsen, 1986), low importance attached to oral hygiene (Søgaard *et al.*, 1991), apathy and loss of motivation (Hickey, 1988; Schou & Eadie, 1991; Merelie & Heyman, 1992; Collis & Stafford, 1994).

2.4.5.2 Factors affecting utilisation of dental care

In contrast to their high utilisation of medical services, elderly people are less likely to seek dental care than younger age groups (Kiyak, 1989; Ettinger, 1997). There appear to be a number of factors that may explain this phenomenon, mostly patient-related, although some may be related to the way carers or dentists view treatment of the very old.

Patient-related factors

Elderly people's attitudes to dentistry have been shaped by cultural factors and experience. People now aged over 80 were brought up to view dental care as a luxury, and dentists were consulted only when pain or discomfort supervened. Treatment consisted mainly of extractions and the provision of dentures, which most people thought should last their lifetime (Ettinger, 1992). With high levels of edentulism in the oldest age groups, this pervasive attitude may explain why utilisation rates are low. A UK study revealed that among independently living elderly, 75% were assessed by a dentist as being in need of treatment, but only 22% perceived themselves as needing treatment and only 24% showed any desire for it; 20% of dentate and 24% of edentulous individuals had not seen a dentist for over 20 years, and 90% of edentates viewed the need for regular dental examinations very negatively (Tobias & Smith, 1987). However, in younger cohorts of elderly, where edentulism rates have fallen, there are signs that dental utilisation has increased, both in the UK and the USA. The best predictor of service use appears to be the presence of natural teeth (Ship & Ship, 1989; Palin-Palokas, 1990; Todd & Lader, 1991; Ettinger, 1997).

Nevertheless, there is abundant evidence of a low perceived need, compared to normatively assessed need, for dental treatment in the elderly, including studies by Smith (1979), Tobias & Smith (1987), Wilson *et al.* (1987), MacEntee *et al.* (1988), Tervonen & Knuuttila (1988), Diu & Gelbier (1989) and Lester *et al.* (1998). Many individuals do not attach any significance to dental symptoms (Hickey, 1988), others view dental care only as a problem-solving measure (Blaikie, 1979; Schou & Eadie, 1991; Lester *et al.*, 1998).

Perceived need may remain low because elderly people tend to accept poor oral health as an accompaniment to old age (Kiyak, 1988; Schou & Eadie, 1991). They may be reluctant to report symptoms to anyone else for fear that the symptoms are trivial or unavoidable (Berkey, 1988) or that, if already in poor health, they may lose autonomy over their lives (Hickey, 1988). Brody & Kleban (1981) found that 56% of elderly people's symptoms were not reported to health professionals, and a large proportion were not reported to anyone. Reasons included the feeling that nobody cared, the condition could not be improved or that the patient did not want to bother anyone.

The other principal reasons for low service utilisation are problems with transport or access to surgeries, cost of treatment and fear, cited by many authors (including Smith, 1979; Finch, 1988; Ettinger, 1992; Merelie & Heyman, 1992; Strayer, 1995; Lester *et al.*, 1998). However, fear may be less of a deterrent in people aged over 70, who have been reported as having the lowest rates of dental anxiety (Locker & Liddell, 1991; Todd & Lader, 1991).

Carer-related factors

With dependent individuals, carers may be a significant influence on whether the client seeks dental care. Berkey *et al.* (1988) reported that 65% of dentists and 49% of nursing home staff complained about families' lack of interest, this being perceived as the second most important barrier after financial constraints. Wetle (1987) believes that families are not only unaware of elderly people's dental needs, but are hampered in participating in decision-making by difficulties in balancing their concerns for their relative's health with those for his/her autonomous wishes.

Around 40% of dentists also blamed care staff for apathy (Berkey *et al.*, 1988). Even when nursing homes in a USA study (Waldman, 1967) were offered a free, comprehensive domiciliary dental service, only 30% replied to the initial offer and few accepted it. Homes were reluctant to pay for treatment when they were the client's guardians, and were unhelpful about providing space or personnel to help the dental team. This type of behaviour suggests paternalism on the part of nursing home

management in making a decision to withhold the opportunity for dental care without reference to clients (Wetle, 1987).

Sometimes, families and professional carers may be so overwhelmed by clients' other care needs that oral care is ignored (Wetle, 1987). Alternatively, they may be poorly informed about basic oral health (McCord & Wilson, 1994) and likely cost of treatment (Lester *et al.*, 1998). Barriers perceived by carers, often different from those seen by their clients, included lack of transport, lack of an escort, clients' poor health and the lack of perceived benefit of dental care for clients. Younger carers, paid carers and those who had regular dental care themselves were more likely to anticipate a benefit (Lester *et al.*, 1998).

Dentist-related factors

The dentist's assessment of treatment need may be influenced by ageism (Mann *et al.*, 1988; Gilbert, 1989; McCord & Wilson, 1994), dental attendance patterns (Kay & Blinkhorn, 1987), prospects of remuneration and poor knowledge about gerodontology (MacEntee *et al.*, 1988). Accessibility of the dental premises may pose problems, especially for clients with poor mobility, while domiciliary treatment may be limited either by the dentist's unwillingness to carry out certain types of treatment outside the surgery or by the lack of suitable equipment (McCord & Wilson, 1994).

2.5 Quality of care in nursing homes: personal care and oral health care

In Section 2.5, the literature on factors affecting the quality of holistic nursing home care will be reviewed to identify:

- how factors affecting the policy and management of homes contribute to the overall quality of care

- how specific barriers impede the delivery of adequate oral health care for clients.

Many studies have shown that oral health is worse in nursing home clients than in community-dwellers of similar age. Concern for the oral health status of institutionalised elderly people was first voiced over 25 years ago (Waldman, 1967; Ritchie 1973). Since that time, poor oral health among institutionalised people has been reported by a host of dental and nursing authors, including Manderson & Ettinger, 1975; Booth & Leverett, 1976; Gannon & Kadezabek, 1980; Empey *et al.*, 1983; MacEntee *et al.*, 1985; Schou *et al.*, 1987; Stockwell, 1987; Vigild, 1987, 1988, 1989; Wilson *et al.,* 1987; Berkey *et al.*, 1988; Ekelund, 1988, 1989, 1991; Ley & Langsjoen, 1988; Tobias & Smith, 1987; Mersel, 1989; Pisanty *et al.*, 1989; Stuck *et al.*, 1989; Cardash *et al.*, 1989; Hoad-Reddick *et al.*, 1990; Pietrokovski, 1990a, 1990b, 1995; Hoad-Reddick, 1991; Jorge *et al.*, 1991; Strayer & Ibrahim, 1991; Wilkieson *et al.*, 1991; Fiske & Lloyd, 1992; Merelie & Heyman, 1992; Miyazaki *et al.*, 1992; Kiyak *et al.*, 1993; Jokstad *et al.*, 1996; Knabe & Kram, 1997; Lester *et al.*, 1998.

What are the reasons for these researchers' findings? Undoubtedly, the poorer general health of nursing home clients influences their oral health (Ekelund, 1988; Vigild, 1989). They experience the same oral health problems and barriers to dental care that other elderly people encounter, but their situation is likely to be further compromised by their chronic ill health, which may have led to apathy and loss of motivation for oral health care (Hickey, 1988). Their ability to perform oral hygiene is likely to be diminished by impaired dexterity (Felder *et al.*, 1994a), which has been shown as a strong predictor for admission to nursing homes (Ostwald *et al.*, 1989). On admission, due to preceding difficulties with self-care, they are already likely to have poor plaque control with all its associated problems (Holm-Pedersen *et al.*, 1991). However, elderly individuals are admitted to nursing homes in order to receive what they, their families and probably the nursing home, too, expect to be complete personal as well as health care. As far as oral health care is concerned, this is obviously not administered effectively or universally.

The literature suggests that nurses' awareness of oral health is low, that there are few clear nursing home policies on oral care standards and that staff have poor understanding and practical skills in this area. As a result, oral care is often neglected or inadequately performed. Some studies have indicated that carers' attitudes to oral health vary, but in general, they appear receptive to offers of training and help from the dental team. This offers some hope for interventions targeted at these health workers.

2.5.1 Factors affecting quality of personal care

2.5.1.1 Registration and role definition of nursing homes

All UK nursing homes are required by the 1984 Registered Homes Act to register with and be regularly inspected by the local health authority. Todd's (1990) survey of nursing homes noted the Act's clear underlying assumption that nursing home residents need high dependency nursing care, whereas people in residential homes do not. This trend towards high-dependency resource has recently been observed in UK nursing homes by Nazarko (1996). Her findings support the report by Ernst and Whinney (1986) that the dependency of cognitively unimpaired elderly nursing home clients was at least twice that of residential home clients. Geriatricians recognise the distinction between nursing homes and lower dependency residential homes; they tend towards the opinion that there is no major role for residential care that fulfils anything less than a nursing home function, and that persons not needing nursing care should be supported in their own homes. This high dependency caring role for nursing homes is anticipated to continue for some time to come due to demographic pressure (Coni *et al.*, 1993; Wallack & Cohen, 1988).

2.5.1.2 Funding of homes

Most UK nursing homes for the elderly are privately owned (Ernst & Whinney, 1986). Homes with less than 20 beds tend to be owner-managed, while larger homes are usually owned by a business enterprise. Todd (1990) found that profit margins are

often low, and that smaller homes frequently have no contingency funds for unexpected crises. This situation is exacerbated when a large proportion of residents are on income support, and therefore not paying the true charge for their care.

Financial stringency may affect various parameters of care quality. A study in Australia (Jenkins & Braithwaite, 1993) found that for-profit homes were more likely to save costs by reducing legal compliance levels. In the USA, not-for-profit homes were found to provide a significantly higher quality of care, evidenced by better staffing and better outcomes, including better oral health (Kiyak *et al.*, 1993; Aaronson *et al.*, 1994).

2.5.1.3 Staffing levels and turnover

Average staff levels in UK nursing homes are around one full-time equivalent per client. About 25% of staff are trained nurses, 40% are auxiliaries and 20% are domestics (Ernst & Whinney, 1986). Because of clients' high dependency needs, the Act's requirements are stringent regarding staffing levels and require the presence of qualified nursing staff. However, some owners feel that nurses, trained in acute hospitals, are not necessarily the most suitable staff for chronic nursing, which requires 'tender, loving care' (Hughes, 1981; Todd, 1990).

In practice, up to 90% of basic care, including oral health care, is delegated to low-paid, untrained auxiliary staff, many of whom are paid less than Whitley Council recommendations (Herriman & Kerschbaum, 1990; Todd, 1990; Chalmers *et al.*, 1996). In the USA, Burgio & Burgio (1990) observed the same low socio-economic status of care assistants. Low pay, lack of career pathways and the stressful nature of the job can lead to high turnover and a high proportion of inexperienced staff (Minkler, 1984; Wetle, 1987; Kaz & Schuchman, 1988; Burgio & Burgio, 1990). However, turnover tends to fall if carers feel they are appreciated and are formally consulted or involved in care-plans (Sheridan *et al.*, 1992; Banaszak-Holl & Hines, 1996).

2.5.1.4 Direction

Perhaps the greatest influence on the quality of care is the matron or director of nursing. Studies in Australia, (Pearson *et al*, 1992; Jenkins & Braithwaite, 1993) and the USA (Sheridan *et al.*, 1992) identified the attitude, commitment and interpersonal skills of nurse managers as the main factors affecting staff attitudes, nursing home environment and organisational climate. Poorly managed homes were marred by lack of clear policy objectives and a lack of regard for untrained staff.

There was disagreement between Sheridan *et al.* (1992) and Aaronson *et al.* (1994) about whether inadequate supervision contributed significantly to poor quality care. It certainly appears from a survey in Scotland (Booth *et al.*, 1990) that managements are frequently unaware of how effectively their good practice policies are implemented; the authors observed a 'cooling effect', whereby adherence to good practice lessened the closer one got to operational reality, especially with practices which carried some risk, inconvenience or extra work for the carers. Bowers & Becker (1992) reported similar findings in the USA, and highlighted oral health care as the most common casualty when staff were skimping on care.

These findings reflect the problems of introducing new practices for care staff and indicate that, with any routine, management needs to provide effective leadership and careful monitoring to ensure that good practices are instituted and maintained. Nurse managers may experience difficulty and role stress if they lack either adequate policies or the authority to perform the type of care they are delegating to other staff (Hughes, 1981). For dental personnel wishing to train staff in oral health care, it may therefore be advisable to educate and train qualified nurses as well as auxiliary staff.

2.5.1.5 In-service staff training

Although most nursing home managers subscribe to the principle of training unskilled staff, little is done to achieve this goal. Todd's (1990) survey showed that very few homes held regular staff meetings or teaching sessions, but relied on carers gaining experience from daily working with other staff. Many managers considered that in-

service training should not be the responsibility of the nursing home, but should be provided by the NHS or training colleges. Regardless of where training takes place, an oral health care input from dental professionals is likely to be advantageous.

Pearson *et al.* (1992) found no evidence that a high proportion of untrained staff had a deleterious effect on quality of care, However, widespread lack of continuing professional education and staff training has caused concern among other health professionals. Dilley (1990) attributed the outdated and inappropriate care which she observed in nursing homes to this cause. Gerontological nurses in the UK and USA expressed needs for education on nearly all gerontology topics (Timms & Ford, 1995). Care assistants in the USA felt an overwhelming need for additional general training (Burgio & Burgio, 1990), while carers in several dental studies have expressed similar needs in respect of oral health care, both in the UK (Lloyd, 1990; Fiske & Lloyd, 1992; Frenkel & Harrison, 1995) and the USA (Herriman & Kerschbaum, 1990). A conference paper by Wallack & Cohen (1988) on the costs of long-term care deplored the lack of training offered by professionals and expressed concern that, in the supposedly supervised institutional setting, staff who performed the majority of care had the lowest levels of training. Sadly, there is still evidence of a lack of investment and structures for continuing education in nursing homes (Morse & Jenkinson, 1995; Nazarko, 1996).

2.5.1.6 Staff attitudes

Several surveys have shown that health care professionals hold negative attitudes and stereotypical views towards the elderly (Boyd, 1981; Dolinsky & Dolinsky, 1984; Fishman, 1989; Gilbert, 1989). Ageist attitudes may result in a lower standard of care being offered to elderly patients, who are often aware of what is happening, but passively accept it (Gilbert, 1989).

The motivation of carers was studied in the USA by Bowers & Becker (1992). In-depth interviews indicated that carers were either economically motivated (cutting corners and providing poor quality care) or affectively motivated (soon leaving the job because they were uncomfortable with giving less than ideal care). This rather bleak

conclusion probably emphasises opposite ends of an attitude continuum, but nevertheless provides an interesting perspective. In the UK, Todd (1990) found a more moderate atmosphere. Nursing home staff took pride in the service they were providing, often describing residents being cared for 'as though they were your own parents'. Weeks & Fiske (1994) reported care assistants' similarly strong sense of holistic caring, including provision of oral care. As with any personal interaction, mutual respect and empathy have been identified as enhancing good relations between staff and clients (Heiselman & Noelker, 1991).

2.5.1.7 Quality of care from the client's perspective

Admission to a nursing home can be a traumatic life event. Grau *et al.* (1995) discussed problems of adjustment to new routines, relinquishment of privacy and dependency on strangers for physical and psychosocial needs. These factors can lead to elderly people experiencing low morale after institutionalisation (Vogel & Mercier, 1991). Regulatory activities tend to concentrate on material aspects of care, such as hygiene and fire regulations. Equally important, but more difficult to measure are resident-centred outcomes, such as personal dignity and loss of choice (Wallack & Cohen, 1988).

However, residents' responses in several studies of nursing home quality have proved problematical. Pearson *et al.* (1993) and Grau *et al.* (1995) found that residents expressed a degree of positive satisfaction with their care that did not always correlate with observers' impressions. Both studies suggested that residents were concerned about the consequences of criticising the home or the staff. Anodyne replies from clients typify the behavioural changes that often occur after institutionalisation, including apathy, immobility and passive acceptance (Coni *et al.,* 1993), regression and learned helplessness (Dolinsky & Dolinsky, 1984). The development of these traits would make it very unlikely that clients would request a higher standard of care (such as denture and dental hygiene care) than that which was offered.

Qualitative techniques reveal deeper insights into carer-client relationships and emphasise the great influence of carers on clients' quality of life. Studies by Grau *et*

al. (1995) and Wilde *et al.* (1995) identified the importance of clients' interpersonal relationships with care staff in both 'best' and 'worst' experiences. Lack of sensitivity to reasonable individual needs resulted in clients receiving poor quality care. The high degree of reliance on care assistants rather than qualified nurses confirms Power's (1990) opinion that where oral care is concerned, auxiliary staff are the dental team's greatest foe or greatest ally.

2.5.2 Factors affecting the quality of oral health care

The ideal management of oral health care for nursing home clients would include a commitment by the home to the implementation of appropriate policies and guidelines, regular assessment of the clients' oral health needs and regular professional dental examinations; clients should be offered the opportunity for daily oral hygiene with, where necessary, assistance from staff who have been adequately trained and are regularly monitored. In practice, nursing home oral health care appears to be ineffective, haphazard and frequently neglected. The points at which deficiencies arise - policy making, training, performance, knowledge and attitude - will be considered.

2.5.2.1 Priority, policy and guidelines

The majority of policy decisions about health care of clients in nursing homes tend to be taken by the owners, a large proportion of whom are nurses (Todd, 1990). Doctors, although often involved with nursing homes, play less part in their management, compared to their role in hospitals (Castle & Banaszak-Holl, 1997). Unfortunately, training of both these professions appears largely to ignore the mouth and common oral diseases, a situation that Nettleton (1995) attributes to the way dentistry became recognised as a legitimate branch of medicine. A body of knowledge about the mouth built up from the mid-nineteenth century, the mouth became an object of public health surveillance in the twentieth century, and dentistry was legitimised as a profession by successive Dentists' Acts in 1878 and 1921. Despite being the largest specialised sub-branch of medicine, it is taught only in specialised schools, tending to maintain a separation from the parent discipline. As a result, the mouth has become 'separated'

from the rest of the body, and knowledge and awareness of oral health is poor among doctors and nurses (Diu & Gelbier, 1987; Rak & Warren, 1990; Merelie & Heyman, 1992; Kite, 1995). Although multi-disciplinary teams are considered advisable in geriatric care (Challis *et al*, 1991; Morse & Jenkinson, 1995), dentists are almost never considered as potential team members (Quinn, 1988; Diu, 1992; Henry, 1995).

When health professionals' low awareness of oral health is compounded by clients' low perceived need for treatment and inability to articulate any expressed need effectively (Quinn, 1988), it is not surprising that oral health is a low priority in nursing homes. This phenomenon has been observed by many researchers, including Blaney (1986), Berkey *et al.* (1988), Ley & Langsjoen (1988), Pietrokovski *et al.* (1990a, 1990b), Logan *et al.* (1991), Eadie & Schou (1992), Vigild (1992), Kambhu & Levy (1993) and Frenkel & Harrison (1995). In Scandinavia, Ekelund (1989) found an alarming ignorance among nursing home directors, 80% of whom considered dental care less important than hairdressing. Oral health frequently has a lower priority than chiropody and failing sight or hearing (Tobias & Smith, 1987; Vigild, 1992).

The result of this lack of awareness of oral health is that few homes observe any guidelines for oral health care (Empey *et al.*, 1983; Ley & Langsjoen, 1988; Kiyak, 1989). Little or no assessment of clients' oral health care or treatment needs takes place (Diu, 1992; Hoad-Reddick, 1992; Henry, 1995; Kambhu & Levy, 1993; Adams, 1996). Scant arrangement is made for treatment or regular dental check-ups (Tobias & Smith, 1987; Vigild, 1989; Hoad-Reddick, 1991; Strayer & Ibrahim, 1991; Soh, 1992; de Baat *et al.*, 1993; Kiyak *et al.*, 1993; Knabe & Kram, 1997; Lester *et al.*, 1998). Visiting dentists are rarely viewed as part of the nursing home's team of health professionals (Power, 1990).

2.5.2.2 Oral health training for nurses and care assistants

Both in the UK and the USA, oral health receives low priority in the curricula of nursing schools. In a cross-sectional study of UK nurse training establishments, Longhurst (1998) found that only one out of thirty-eight nursing textbooks had comprehensive coverage of oral care, 79% of schools had no input by dental experts

and 38% did not devote a lecture specifically to oral health; plaque was mentioned in only 38% of schools. Time constraints are commonly cited as the reason for exclusion or minimal coverage of oral care in nursing courses. Oral health occupies on average one hour, although sometimes as little as 15 minutes, during a three year course. Lectures are often based on tradition, not substantiated by research findings (Lewis, 1984). Teaching is usually performed by nurse tutors, who themselves were taught by nurses rather than dental professionals. Outside lecturers are often discouraged and teaching material is inconsistent across different schools (Munday & Gelbier, 1984; Jones *et al.*, 1988; Logan *et al.*, 1991; Stephens, 1997; Longhurst, 1998). Few nurses in Kite's (1995) study could remember toothbrushes being mentioned during their course. Several authors report the continued teaching of procedures that are detrimental to oral and dental tissue, including lemon and glycerine foamsticks, half strength hydrogen peroxide, swabbed fingers, forceps and gauze, and ineffective mouthwashes (Harris, 1980; Trenter Roth & Creason, 1986; Barnett, 1991). Moore (1995) believes nursing mouthcare to be 'little more than banal, ritualistic practice'. In hospitals and nursing homes, there are charts for almost all aspects of care, yet little or no room for oral assessment, either on admission or during the patient's stay (Barnett, 1991; Moore, 1995). Alert patients are usually assumed to be undertaking their own oral hygiene (Hallett, 1984; ; Schou & Eadie, 1991).

There is no shortage of well researched papers in the nursing press to help nurses improve procedures. Twenty years ago, nursing research by Howarth (1977) exposed the ineffectiveness of foamsticks and reviewed the 'vast evidence' in favour of the toothbrush. Since then, articles with sound oral hygiene advice have regularly appeared, including DeWalt (1975), Ettinger & Manderson (1975), Block (1976), Gannon & Kadezabek (1980), Schweiger *et al.* (1980), Hallett (1984), Blaney (1986), Geissler & McCord (1986), Trenter Roth & Creason (1986), Harrison (1987), Alderman (1988), McCord & Stalker (1988), Ebersole & Hess (1990), Kite (1995) and Pearson (1996). However, nursing practice has persisted in providing only token oral health care, often excluding the use of toothbrushes. Useful as the written word may be, health workers are likely to need more direct, practical tuition from dental experts before habits will change, as subjects' responses in some studies have

recognised (Lewis, 1984; Munday & Gelbier, 1984; Barnett, 1991; Moore, 1995; Stephens, 1997).

When qualified nurses have such a low level of knowledge and competence in oral health care, they are unlikely to achieve much useful training of their auxiliary staff. Morse & Jenkinson (1995) observed that many homes have no dedication to formal training, and inquired whether there should be a mandatory commitment. Several studies have found that, almost without exception, care assistants have not received any form of oral health care training (Cardash *et al.*, 1989; Lloyd, 1990; Logan *et al.*, 1991; Merelie & Heyman, 1992; Weeks & Fiske, 1994; Frenkel & Harrison, 1995; Ettinger, 1997). Even when homes provided in-service dental training, around 60% of aides in a USA study did not attend (Chalmers *et al.*, 1996). Other researchers reported severely limited levels of oral health knowledge and understanding among carers (Tobias & Smith, 1987; Christensen, 1992; Fiske & Lloyd, 1992; McCord & Wilson, 1994; Adams, 1996; Jokstad *et al.*, 1996). In a number of studies, carers expressed their need for better oral health training (Herriman & Kerschbaum, 1990; Lloyd, 1990; Fiske & Lloyd, 1992; Chalmers *et al.*, 1994; Frenkel & Harrison, 1995; Wårdh *et al.*, 1997).

2.5.2.3 Levels of oral health care provided in nursing homes

Some countries, notably the USA and Australia, have national regulations governing oral health care provision in institutions. While regulations make it more likely that institutional policy makers will be made aware of the need for oral health care, they do not guarantee that nursing homes will comply with the regulations (Booth & Leverett, 1976; Jenkins & Braithwaite, 1993; Kambhu & Levy, 1993). Even when client assessment is mandatory, the client may not benefit; Thai *et al.* (1997) found that Minnesota nurses assessing clients identified only a small minority (3% or less) as having oral debris, unsound teeth, soft tissue problems or pain, and that the few problems identified did not, as the regulations specified, trigger automatic referral for dental care. In countries where there are no formal regulations, the level of oral health care provision will depend on the priority accorded to it by the institutions' managements (Ekelund, 1989). Several studies have attempted to assess oral health

provision in nursing homes, mainly from managers' responses to questionnaires. The results must be interpreted with caution, since it was not usually possible to validate the data. However, the results are relatively similar, suggesting reasonable accuracy.

Professional dental care appears to be sporadic, mainly curative and given to very few in each home. In Singapore, Soh (1992) contrasted in-house medical care (offered in 43% of nursing homes) to in-house dental care (offered in 6% of homes). Ekelund (1991) in Finland and Hoad-Reddick (1992) in the UK found that only 16% of homes were visited regularly by a dentist, compared to routine visits by hairdressers, pharmacists and chiropodists. Although 40% of residents in another study by Hoad-Reddick & Heath (1995) had seen a dentist in the preceding two years, only one-third of subjects in a German survey (Knabe & Kram, 1997) had been seen by a dentist in the last five years. When the proportion of dental visits arranged solely in response to problems was recorded, several European studies showed similar findings in the 84-96% range (Ekelund, 1989, 1991; Vigild, 1989; Hoad-Reddick, 1992; de Baat *et al.*, 1993; Knabe & Kram, 1997). Merelie & Heyman (1992) found that staff did not refer patients for treatment, even when there was evident need, such as broken teeth or dentures. Clients suffered fewer problems when dentists made regular visits (Hoad-Reddick & Heath, 1995). However, when staff fail to recognise the importance of oral health, it must be very difficult for elderly people to get dental treatment.

Although oral health should be included in all assessments of clients on admission to homes, two European studies reported that it occurred with only 11-16% of clients, and was performed by a dentist in less than half of those cases (Ekelund, 1991; Hoad-Reddick, 1992). Even in the USA, where oral health assessment is mandatory, two studies found that 34-42% of clients were not appraised on admission (Booth & Leverett, 1976; Kambhu & Levy, 1993). In a geriatric hospital survey in the UK, 62% of nurses thought that oral assessment of patients on admission was unnecessary (Adams, 1996). Even where assessments are attempted, some are clearly deficient, such as asking clients to grade their own ability for oral health maintenance (Hoad-Reddick, 1992; Kambhu & Levy, 1993).

Without proper assessment, staff will be unaware of individual oral health needs. Hoyen-Chung (1989) found that, even in a minimal care long-stay unit, where a greater proportion of clients was potentially able to maintain oral health unaided, 80% had poor oral hygiene. In a French geriatric hospital with an oral hygiene programme, only 11% of patients regularly brushed their teeth (Mersel, 1989). A possible explanation may be that staff did not offer either of these groups of patients any opportunity to brush their teeth or dentures.

Both lack of assistance and lack of oral hygiene materials appear as barriers to oral health care. A study by Ekelund (1989) found that half of subjects aged over 85 and half of all dentate subjects in nursing homes had no toothbrush and over half of those needing oral hygiene help received none. Over 25% of facilities in Kambhu & Levy's (1993) study in Iowa acknowledged that not all residents received regular oral health care. Knabe & Kram (1997) found that staff never brushed teeth for dentate clients. However, in New York State, despite one-third of homes failing to provide in-service oral care training, all homes claimed to give direct oral hygiene aid and materials, and oral hygiene standards had improved markedly since a similar study twenty years previously (Booth & Leverett, 1976).

Other surveys of institutionalised elderly people have shown that the oral hygiene of those receiving help from staff was no better, and sometimes worse, than among functionally dependent subjects receiving no assistance (Vigild, 1988; Hoyen-Chung, 1989; Stuck *et al.*, 1989; Merelie & Heyman, 1992). Possibly, ineffective methods are employed. Although staff 'cleaned' 35% of dentures in Knabe & Kram's (1997) study, they did not use brushes. Ineffective alkaline peroxide was used in 64% of Manchester homes (Hoad-Reddick & Heath, 1993) and was also specified in the ward policy in a hospital survey by Wilkieson *et al.* (1991), although staff failed to comply with the policy when they were busy.

Power (1990) recalled the inadequacy of institutional oral care as 'a swat with lemon glycerine and a nightly soak of dentures', although decubitus and perianal care were meticulous. It does not appear unusual for carers to omit any attempt at mouthcare

when they are short of time or personnel, or when clients are unco-operative (Bowers & Becker, 1992; Eadie & Schou, 1992; Kambhu & Levy, 1993; Chalmers *et al.*, 1996; Wårdh *et al.*, 1997). Responses to questionnaires from Hardy *et al.* (1995) and Chalmers *et al.* (1996) reported that tooth- and denture brushing was carried out by a large proportion of auxiliaries, although the authors thought the claims were exaggerated, since many carers felt inadequately prepared for oral health care.

2.5.2.4 Carers' oral health knowledge

A number of studies have attempted to assess oral health knowledge levels, although results have not generally been related to carers' normal practice. Overall knowledge scores were calculated in three studies. In the USA, samples of nurses and care assistants correctly answered 55-71% of questions (Logan *et al.*, 1991; Glassman *et al.*, 1994), while in a UK study of a self-selected and therefore possibly unrepresentative sample of nurses, 50% or more was scored by 85% of the sample (Rak & Warren, 1990).

However, rather than a total score, data have more frequently been presented as proportions of correct answers to specific questions, which is useful in identifying deficient areas of knowledge. Carers in two studies were well-informed on denture-care topics, with 80-87% correct responses, although their knowledge was not translated into practice (Rak & Warren, 1990; Hoad-Reddick & Heath, 1993). On other topics, many nurses and care assistants held common misconceptions and had low knowledge levels on oral health. Studies by Rak & Warren (1990), Logan *et al.* (1991), Fiske & Lloyd (1992), Merelie & Heyman (1992) and Adams (1996) showed that a minority of respondents appreciated the reduced masticatory function suffered by denture wearers (11-14%), the link between oral hygiene and dental disease (5%), the efficacy above all other oral hygiene tools of toothbrush and toothpaste for patients' oral health care (10-30%), the necessity of daily plaque removal to maintain good oral health (33-37%), the function of dental floss in removing plaque rather than dislodging food particles (30%), the insignificance of calcium intake in caries aetiology (25%), the importance of dietary sugar restriction in caries prevention (28%), characteristic appearances of oral cancer lesions (30-33%) and the likely cost

of basic items of dental treatment (16-29%). Only 23-25% of carers realised that denture fixative should normally be regarded only as a temporary measure.

Adams (1996) reported nurses' favourite oral hygiene aids to be mouthwash (unspecified) and ineffective lemon solution and swabs. Disappointingly, Davies & Whittle (1990) found that, even after oral health education, 61% of carers did not associate effective brushing with the prevention of gum disease. Only 55% of nurses in Rak & Warren's (1990) study realised that effective brushing would help to reduce gingival bleeding. However, the majority understood the importance of oral hygiene instruction in the treatment of periodontal disease. In a qualitative study (Weeks & Fiske, 1994), many carers thought that bleeding gums were caused by poor brushing technique, poor diet or general illness, and few related diet to dental decay, even when prompted.

When training was discussed, 30-50% of nurses had not received any oral health instruction during training and 89% had not received any post-qualification tuition. A large proportion of nurses and carers (70-100%) welcomed the opportunity to update their oral health knowledge (Rak & Warren, 1990; Hoad-Reddick & Heath, 1993; Adams, 1996; Stephens, 1997). However, in the studies by Eadie & Schou (1992) and Weeks & Fiske (1994), few care assistants perceived any need for further knowledge or skills, believing that oral health care was 'common-sense'.

2.5.2.5 Carers' attitudes towards oral health care

Both qualitative and quantitative methods have been used to assess carers' attitudes to providing oral health care. Direct comparisons between studies are not possible because parameters varied. Nonetheless, a number of common themes emerged.

The concept of responsibility for clients' oral health care varied markedly in different studies. Eadie & Schou (1992) found that carers in Scotland declined to involve themselves in oral health care. Community carers argued that it was not part of their remit and were averse to considering preventive measures. Hospital carers subscribed to oral health care being part of the care routine, but were reluctant to practise it. In

contrast, 94% of carers in a quantitative study in London saw oral health care as part of their role (Fiske & Lloyd, 1992), as did the majority of subjects in a qualitative study in the same geographical area (Weeks & Fiske, 1994). Pietrokovski *et al.* (1995) and Wårdh *et al.* (1997) found that nearly all nurses held favourable attitudes to oral care, despite difficulties in getting staff to do it. In a study of oncology nurses in the USA, Wallace *et al.* (1997) found that a more positive attitude to oral care was a good predictor of nurses actually carrying out the task.

Cultural factors may importantly influence staff attitudes. Berkey *et al.* (1988) suggested that many care assistants came from cultural or income categories where dental care was a low priority or an expensive luxury, and found it difficult to adjust their priorities when caring for clients. Other studies have found that carers tended to value clients' oral health in relation to their own subjective norms. Lloyd (1990) and Weeks & Fiske (1994) found that carers empathised with the client's loss of self-esteem if oral hygiene were neglected or if halitosis interfered with social interactions. Hoad-Reddick & Heath (1993) reported that 87% of their sample felt strongly about the importance of dentures being functional and aesthetic.

A rather problematical issue that often arises is client autonomy. Carers like to maintain clients' independence and let them carry out their own oral health care if possible (Weeks & Fiske, 1994), and around 60% in Stephenson's (1995) survey valued clients' independence to brush over having a high standard of oral health. Some carers reported that clients did not wish to be helped, others disliked personal encroachment of the client (Berkey *et al.*, 1988; Wårdh *et al.*, 1997). Kambhu & Levy (1993) believed the debate between 'good oral hygiene' and 'respecting the wishes of the client' to be an ongoing challenge involving substantial individualising of approach and decision-making.

Other barriers perceived by carers performing oral health are reviewed below. The data quoted come from studies by Berkey *et al.* (1988), Lloyd (1990), Logan *et al.* (1991), Eadie & Schou (1992), Fiske & Lloyd (1992), Kambhu & Levy (1993),

Weeks & Fiske (1994); Frenkel & Harrison (1995), Kite (1995), Stephenson (1995), Chalmers *et al.* (1996), and Wårdh *et al.* (1997).

The low priority accorded oral care was cited by up to 68% of carers, few of whom were aware of the risks of poor oral health and most of whom felt other tasks were more pressing. The majority of carers had received no oral health care training (54-93%), having to rely on observation of the care routines of colleagues, who were often unable to provide a peer group example. Not surprisingly, many carers found oral health care difficult and problematical. It was often described as unpleasant or repulsive. Carers felt revulsion at touching another person's teeth or dentures, and some feared they might hurt or harm the client. They expressed the desire for freer availability of protective gloves. Some carers became accustomed to oral care, others avoided it wherever possible. In the study by Wårdh *et al.* (1997), 42% of staff rated oral care as the most undesirable task, twice as many as disliked incontinence care, feeding or hairwashing.

Further barriers, which superficially appear as practical issues, may actually have psychological origins or may simply be the result of inadequate training and understanding. A frequent complaint by carers (24-82%) was that clients were uncooperative, a situation that may arise through the client's lack of awareness of the importance of oral health, the carer's ineptitude in performing it, the lack of negotiation between client and carer, or as a convenient excuse for carers not intervening. Lack of time, lack of staff and lack of equipment were also often cited (by 39-55% of carers in these studies), although these problems may be related to those of oral care awareness and prioritisation.

When asked to assess their homes' oral health care, the majority of carers felt that there was insufficient provision; 82% said that if they were residents themselves, they would like their teeth cleaned twice a day and 95% felt that regular dental check-ups should be arranged for clients (Weeks & Fiske, 1994; Stephenson, 1995). Many carers were uncertain of their ability to perform oral health care and 71-93% expressed a

wish for training and practical help from dental experts (Lloyd, 1990; Tobias & Smith, 1990; Fiske & Lloyd, 1992; Hoad-Reddick & Heath, 1993; Frenkel & Harrison, 1995; Stephenson, 1995; Wårdh *et al.*, 1997).

Carers in a UK survey (Lloyd, 1990) were asked about their own oral health. Examination of their mouths revealed a high normative treatment need of 91%. Around half had regular dental check-ups, 60% perceived a current need for treatment, 48% were in pain or discomfort, 44% experienced fear at the prospect of treatment and 33% were reluctant to attend. This suggests that fear of dentistry is still a major barrier to many people. A more encouraging finding was that a high proportion (74%) were interested in learning more about looking after their mouths. The opportunity to capitalise on this expressed interest by providing oral health education might raise carers' awareness of clients' oral care needs and perhaps improve their oral care skills.

2.6 Recommendations, interventions and evaluations by previous researchers

This section will consider the recommendations made by researchers as a result of oral health studies among institutionalised elderly people. Given the universally accepted evidence of poor oral health in this population, the most common recommendation is for oral health education programmes for carers, on whom dependent individuals rely for assistance with oral hygiene. The rationale of evaluating health education will be discussed, and the results of evaluated health education interventions in nursing homes and similar care situations will be reviewed. There are encouraging signs that carers' oral health knowledge, attitudes and behaviour may be positively influenced by educational programmes. These findings led to the design of the present study, which will attempt to relate carers' knowledge and attitudes with their oral health care behaviour and the resulting oral health levels among clients.

2.6.1 Recommendations from oral health studies of dependent elderly people

Elderly nursing home clients rely heavily on staff for assistance with personal and oral hygiene and for access to professional dental care. Staff therefore form perhaps the most important link in the chain of this particular dentist-patient relationship. When oral health is a low priority in the nursing home, staff are likely to fail both in delivering adequate oral health care and in facilitating dental care.

Several researchers have recommended a more active role on the part of the dental profession in raising the priority of oral health with elderly people and as part of multi-disciplinary care with medical and nursing professions. Diu (1992) advised that intervention should begin with pre-retirement education on the importance of oral health in later life and continue with practical assistance in oral hygiene for dependent and handicapped individuals to extend their independence. He further recommended that dental assessments should take place from age 75, in parallel with existing general medical practice assessments, with additional assessment for all those entering residential or institutional care. It is often at the time of institutionalisation that oral care becomes overlooked or neglected. Kiyak *et al.* (1993) felt that nursing home policies on dental care were long overdue for major revision, including development of more active dental programmes involving dentists, hygienists and carers. General support for a multi-disciplinary approach to oral health care was given by Quinn (1988), de Baat *et al.* (1993) and Weyant *et al.* (1993). More specific advice came from Kuramoto (1974), regarding the need for specialist dental help in promoting nursing research into oral care, and from Power (1990), who recommended positive involvement of dentists in nursing homes, so that they became accepted as active staff members.

The low level of dental involvement in nursing home policy-making may be related to low levels of service provision. Recommendations for comprehensive rather than problem-solving dental services have been made by Vigild (1988, 1989, 1993), Stuck *et al.* (1989), Miyazaki *et al.* (1992), Hoad-Reddick & Heath (1993, 1995), Knabe &

Kram (1997) and Mojon *et al.* (1997), In particular, oral screening on admission and thereafter annually have been urged by Wilson *et al.* (1987), Kiyak (1989), Merelie & Heyman (1992), Soh (1992) and Henry (1995).

However, even if this ideal were to be achieved in the future, dentists are unlikely to be in daily attendance at nursing homes. Thus, the main responsibility for daily oral health maintenance of dependent clients will remain with care staff. It is therefore understandable that the researchers' most frequent recommendation has been for training of nursing home staff by members of the dental team. With numbers of elderly people rising, the demand for oral health care is likely to increase, as will nurses' involvement with it (Rak & Warren, 1990). The need for oral health to be included in curricula for both formal nurse training and more informal in-service staff training has been advocated and the need for regular reinforcement has been recognised by Wilson *et al.* (1987), Logan *et al.* (1991), Eadie & Schou (1992) and Kambhu & Levy (1993). The interaction of knowledge, attitudes and behaviour has been appreciated, and the supplementation of information with demonstration and practice of oral care techniques has been endorsed by the US Surgeon General (1988), Rak & Warren (1990) and Logan *et al.* (1991). Other researchers have emphasised the need to base training on carers' needs, focusing on interventions that care staff could realistically achieve and which would break down the barriers to providing effective oral hygiene (Eadie & Schou, 1992; Kambhu & Levy, 1993).

Further support for the principle of educating staff in oral health care has come as result of studies by Vigild (1987), Ekelund (1988), Hoyen-Chung (1989), Jorge *et al.* (1991), Wilkieson *et al.* (1991), Fiske & Lloyd (1992), Merelie & Heyman (1992), Miyazaki *et al.* (1992), Soh (1992), de Baat *et al.* (1993), Hoad-Reddick & Heath (1993, 1995), Knabe & Kram (1997), Mojon *et al.* (1997) and Wårdh *et al.* (1997). Oral health education for carers therefore appears to be the intervention that researchers familiar with the nursing home setting anticipate as being the most likely to achieve significant improvements in clients' oral health.

2.6.2 Evaluating oral health education in the nursing home

A technical definition of health education has been proposed by Tones & Tilford (1994):

> 'Health education is any intentional activity which is designed to achieve health or illness related learning, i.e. some relatively permanent change in an individual's capability or disposition. Effective health education may, thus, produce changes in knowledge and understanding or ways of thinking; it may influence or clarify values; it may bring about some shift in belief or attitude; it may facilitate the acquisition of skills; it may even effect changes in behaviour or lifestyle.'

Various ideological models of health education have been defined - educational, preventive, radical, empowerment - mostly based on philosophy and values rather than on function and learning theory. All of them represent attempts to impose meanings on complex realities. However, the definition quoted above holds true, irrespective of the model adopted, just as the mechanisms of human learning remain the same. Evaluation of health education thus defined would then be to determine to what extent health or illness related learning had taken place (Tones & Tilford, 1994).

The process by which knowledge is believed to result in behavioural change is a complex continuum of events; knowledge may transform unawareness to awareness. However, before action is taken, an element of self-interest is necessary, since people are more likely to respond to oral health education if it is linked to problems they have experienced; the health education message may result in a positive attitude and a belief that a change in behaviour would be beneficial; however, unless individuals feel committed to that change, they will fail to take the necessary action (Blinkhorn, 1981; Cushing *et al.*, 1986).

When health education is evaluated, different types of assessment may be carried out. Judgement about the value of the intervention may be made from the perspective of process evaluation (the appropriateness of methods employed), formative evaluation (shaping a programme as it unfolds, sometimes called action research) or summative evaluation (focusing on outcomes and the achievement of objectives) (Shiroyama *et*

al., 1995). Evaluation is an important component of health education, not only to improve the quality of future interventions and identify unexpected outcomes, but also to justify the resources used and to provide evidence of the programme's effectiveness in improving health (Ewles & Simnett, 1995).

Much health education is still not formally evaluated or else is too narrowly focused. Too often, activity has been carried out without recourse to a scientific research design (Blinkhorn, 1998). The impact of many oral health education initiatives has frequently been assessed using self-reported or subjective measures (Munday & Gelbier, 1984; Woodall, 1997). Alternatively, participants' knowledge or attitudes have been examined in isolation from their customary practice (Davies & Whittle, 1990; Glassman *et al.*, 1994). Although these measures evaluate part of the education process, dental diseases are largely behavioural in origin. Evaluation of oral health education should therefore include indices that reflect behavioural change (Blinkhorn, 1981). In the context of the present study, the best indices of behaviour in the target population (carers) are likely to be those that record oral health status in the client population. Evaluations of this type have only rarely been undertaken; examples include the study by Vigild (1990) with dentate and edentate clients, the study by Nicolaci & Tesini (1982) with dentate clients and the study Schou *et al.* (1989) with denture-wearing clients.

2.6.3 Evaluations of health education interventions in other studies

Compared to the widespread use of descriptive surveys in recording the oral health of institutionalised elderly people or the knowledge and attitudes of their carers, there have been relatively few intervention studies based on those populations. Most of the reported interventions have assessed the impact of health education in relation to carers' knowledge or their perceptions of the usefulness of the education programme. Some studies have reported changes in carers' practice without evaluating its effect on clients' oral health. A small number of clinically related evaluations of health

education have taken place, but none of them has employed the same combination of target groups and clinical outcome measures as the present study. However, as there are circumscribed areas of common interest, the evaluation studies are compared below, and are summarised in Table 2.2.

2.6.3.1 Studies evaluating acceptability of health education to carers

When Eadie & Schou (1992) limited oral health care education to distributing leaflets among carers, who had already been found to hold negative attitudes, the intervention was not well received. However, more comprehensive and interactive health education programmes involving student nurses (Munday & Gelbier, 1984), nursing home care assistants (Woodall, 1997) and carers of mentally handicapped adults (Davies & Whittle, 1990; Glassman *et al.*, 1994) were all received very positively, although none was evaluated by reference to clients' oral health levels. The studies shared common objectives of explaining the role of plaque in dental disease, enabling unhealthy mouths to be recognised, identifying problems of maintaining clients' oral health and understanding the importance of oral health and oral hygiene to clients' physical and psychological well-being. Davies & Whittle (1990) specifically reported a practical training element; the other three studies may have included practice too, although they did not state that it had taken place. The quantitative assessments reported by Munday & Gelbier (1984) and Davies & Whittle (1990) showed that 100% of the participants found that the programmes were enjoyable, useful and had raised their awareness of the importance of oral hygiene to patients. Participants in the programme of Glassman *et al.* (1994) rated it 'above average' to 'outstanding'. Glassman *et al.* (1994) also reported qualitative data, as did Woodall (1997), indicating carers' increased awareness of oral health and their intention to practice new-found knowledge and skills. However, although Woodall (1997) claimed improved mouthcare for clients, her assertion seems to have been based on unverified self-reporting by participants. The enthusiastic reception of these four interventions resulted in all of them being incorporated into regular carer training programmes.

Table 2.2: Oral health education interventions and evaluations

Key to study design:
1 = pre-post intervention measures, randomised controlled study; 2 = pre-post intervention measures, no control group; 3 = post-intervention measures only ± control

Authors, year and location	Study design	Target group and sample size	Health education methods & duration	Evaluation parameters and methods	Conclusions
Studies evaluating practical skills following OHE					
Kite (1995) England	2	Intensive care nurses (10)	Talk and demonstration, journal articles. Approx. 30 minutes	Nurses' use of toothbrushes on intubated patients in intensive care unit (Observation, semi-structured interview)	Oral health care understanding and attitudes improved after training
Arvidson-Bufano *et al.* (1996) USA	2	Nursing home nurses (18 nurses, 50 clients)	Lecture, demonstration of oral examination plus hands-on supervised practice. 30 minutes	Accuracy of nurses' oral assessments of clients (Pre- & post-training comparisons with dentist's assessment)	Significant post-training improvement in accuracy of nurses' oral assessments
Studies evaluating health education by clinical oral health assessment					
Nicolaci & Tesini (1982) USA	2	Carers of dentate institutionalised mentally handicapped individuals. (34 carers, 118 clients)	Lectures and practical training of carers. 12 hours in total.	6-monthly plaque scoring examinations of clients (Pre- and post-intervention)	Progressive improvement in levels of oral hygiene, calculus and debris over 18 month period from baseline
Schou *et al.* (1989) Scotland	1	Nursing home clients (201) in 4 allocation groups plus carers (unspecified number)	OHE to small groups of carers only/ residents only/carers + residents. 3 hours (3x1 hour)	Clients' oral health and denture hygiene. (Examination and structured interview pre- and post-intervention)	Little impact on client outcomes compared to control. Slightly improved in groups where carers had OHE, but not statistically significant.
Vigild (1990) Denmark	1	Nursing home clients (201) in 2 allocation groups plus carers (unspecified number)	OHE to carers (Duration not stated)	Clients' oral health and denture hygiene. (Examination pre- and post-intervention)	Greater improvement in intervention group for denture hygiene & denture-induced stomatitis; no improvement in dentate population.
Table continued on following page					

Table 2.2: Oral health education interventions and evaluations [continued from previous page]

Key to study design:

1 = pre-post intervention measures, randomised controlled study; 2 = pre-post intervention measures, no control group; 3 = post-intervention measures only ± control

Authors & year	Study design	Target group and sample size	Health education methods & duration	Evaluation parameters and methods	Conclusions
Studies evaluating acceptability of OHE and/or knowledge levels					
Munday & Gelbier (1984) England	3	Student nurses (67)	Lecture, discussion groups, film, handbook Approx. 2-2½ hours	Quality and usefulness of presentation (Questionnaire)	All participants rated OHE neutrally to very positively
Davies & Whittle (1990) England	3	Homecarers of mentally handicapped adults (44)	Illustrated discussion, demonstration of tooth brushing, practical brushing session 1½ hours	♦Quality and usefulness of presentation ♦Knowledge (Questionnaires)	♦All rated OHE very positively ♦Higher knowledge levels among participants than in control group
Eadie & Schou (1992) Scotland	3	Carers of elderly people (48)	Discussion, leaflet 1-1½ hours	Acceptability of leaflet (Group discussion)	Leaflet poorly received
Woodall (1997) England	3	Nursing home care assistants (11 plus further unspecified number)	Illustrated talk, demonstration 3 hours	Usefulness of presentation (Questionnaire)	All participants rated OHE very positively
Glassman *et al.* (1994) USA	2	Community carers of disabled individuals (20)	Videotape, workbook. 6 hours (2x3 hours)	♦Quality and usefulness of presentation ♦Knowledge (Questionnaires)	♦OHE rated very positively ♦30% higher knowledge levels after OHE than before
Studies evaluating non-clinical assessment skills following OHE					
Palmer (1977) England	3	Health visitors & nurses (Unspecified number of HVs/nurses, 404 clients)	Briefing meeting on administering dental needs questionnaire (Duration not stated)	No evaluation	Health visitors & nurses completed questionnaires without significant problems
Hoad-Reddick (1991) England	3	Care assistants working with elderly people (Unspecified number of carers, 41 clients)	None specified	Carers' ability to assess dental need using questionnaire (compared to dentist-assessed need)	Use of simple questionnaire alerted carers to dental problems requiring treatment

2.6.3.2 Studies evaluating carers' oral health knowledge

Health education interventions combined with knowledge assessment have been reported in two studies of community carers for people with disabilities One study (Davies & Whittle, 1990) assessed knowledge up to a year after the 1½-hour education session and compared responses with a non-participating control group. The differences between the consistently higher scores of programme participants over the control group were statistically significant for 30% of the questions. The small sample size means that the results are not readily generalisable, while the length of time elapsing between intervention and evaluation may have permitted contamination of the control group, for example, if dental health education information had been passed on to them by colleagues who had received the intervention. Another study (Glassman *et al.*, 1994) tested carers before and after six hours of training, and found a highly statistically significant increase in knowledge of almost 30% over baseline. However, the result should be cautiously interpreted since the study sample was small and there was no control group. Nevertheless, the results were sufficiently positive for Davies & Whittle (1990) and Glassman *et al.* (1994) to conclude that carers were able to learn from the teaching methods employed.

2.6.3.3 Studies evaluating carers' practical skills

Several researchers have studied the possibility of oral assessment of elderly people by non-dental personnel, an option that may have some advantages. For example, non-dental staff would be cheaper to employ than professional dental personnel, and in view of dental manpower shortages in many areas, could potentially achieve a wider coverage of elderly people. Palmer (1977) and Hoad-Reddick (1991) devised simple questionnaires for administration by carers or health visitors without special dental training. Both questionnaires proved effective in identifying potential treatment needs and alerting carers to clients' oral health requirements. Arvidson-Bufano *et al.* (1996) used a 30-minute training session for nursing home nurses to teach them how to perform an intraoral screening examination and to recognise common oral problems that required referral for professional dental care. The post-training agreement of nurses' assessments with a dentist's findings significantly improved compared to pre-

training scores. These three studies suggest that relatively simple measures undertaken by minimally trained staff can raise awareness of clients' dental needs. However, with the exception of Palmer's (1977) study, sample sizes were small and may not be generalisable. A larger study by Thai *et al.* (1997) showed contradictory findings; nurses using a dental assessment questionnaire identified only around 5% of dentist-assessed treatment needs.

Another small study (Kite, 1995) observed nurses before and after mouthcare training in an intensive care unit. Knowledge and frequency of toothbrush use improved after training, and qualitative data showed that nurses' fears and concerns about brushing the teeth of intubated patients had largely been dispelled. Kite's (1995) findings suggest that increasing carers' knowledge and skills in the normal working context may facilitate provision of oral health care for dependent clients.

2.6.3.4 Studies evaluating health education by clinically assessing subjects' oral health

In the studies described below, some researchers investigated the effects of targeting health education directly at elderly people, while others targeted carers with health education and assessed the effects by reference to the oral health of the clients.

Among healthy, non-institutionalised elderly people, health education can, under some circumstances, be effective, as Ambjørnsen & Rise (1985) found with one of their two intervention groups in a denture hygiene study. However, the dependence and poorer general health of institutionalised individuals appears to mitigate against successful attempts to improve health-related behaviours. In Scotland, Schou *et al.* (1989) provided health education on denture hygiene to three intervention groups of residents and carers, either alone or in combination. The programme had very little impact on the outcome variables in any group. Cultural factors may have affected this study, since the lack of the intervention's impact on residents and carers seems to reflect the resistance to health information among a sample of Scots in another study (Schou & Eadie, 1991). In the case of the residents, the authors considered that many were too old or unwell to benefit from the programme. Other non-dental health promotion

interventions in nursing homes have also concluded that only clients who are functioning reasonably well are likely to benefit (Breen, 1989; Robertson, 1991; Richardson, 1992).

More encouraging results have been obtained by targeting carers rather than clients. In a longitudinal study among carers of mentally handicapped individuals in the USA (Nicolaci & Tesini, 1982), carers were trained to become 'oral health experts', in their turn training other staff. A disclosed-plaque scoring system, based on the same method used in the present trial (Greene & Vermillion, 1964), was used to record clients' oral hygiene indices at 6-monthly intervals. While not approaching a plaque-free level, clients showed a significant and progressive linear plaque reduction over the 18-month study period. The study participants were not compared to a control group, although the success of this intervention and its wide acceptance by staff led to its continuance for a further 2½ years at least, up to the publication of the report. In a similar Danish study (Vigild, 1990), carers in one nursing home were informed about oral health problems and oral hygiene procedures, while carers in a second home received no training. The improvements in clients' oral health in the intervention home exceeded that in the control home by 12% for denture-induced stomatitis and by 23% for denture hygiene. However, no improvement was seen in the oral health of dentate clients.

2.6.4 Conclusions from intervention studies

It seems likely that the majority of nursing home clients lack the requisite ability for self-care for them to benefit from direct health education aimed at promoting health-related behavioural change (Breen, 1989; Schou *et al.*, 1989; Richardson, 1992). However, health education interventions targeted at carers appear to have produced more promising results in improving clients' oral health.

Carers' interest in oral health care has not been universal. Two qualitative studies have found carers resistant to the idea that they might usefully improve their knowledge or skills (Eadie & Schou, 1992; Weeks & Fiske, 1994). However, many other researchers have found carers enthusiastic to learn more about oral health care

(Rak & Warren, 1990; Fiske & Lloyd, 1992; Hoad-Reddick & Heath, 1993; Frenkel & Harrison, 1995; Adams, 1996; Stephens, 1997). Participants in training programmes appeared to value them positively (Munday & Gelbier, 1984; Davies & Whittle, 1990; Glassman *et al.*, 1994; Woodall, 1997) and the programmes appear to have raised oral health awareness, knowledge, motivation and skills (Palmer, 1977; Nicolaci & Tesini, 1982; Davies & Whittle, 1990; Hoad-Reddick, 1991; Kite, 1995; Arvidson-Bufano *et al.*, 1996).

While improvements in knowledge and attitudes are necessary goals in health education, it remains paramount to evaluate the effects of any changes in carers' behaviour by assessing changes in dependent clients' oral health status, since this is the outcome measure where improvement is most desired. This has been recommended by Davies & Whittle (1990), Glassman *et al.* (1994) and Chalmers *et al.* (1996) and has been carried out by Nicolaci & Tesini (1982), Schou *et al.* (1989) and Vigild (1990). Results have mostly been encouraging. Vigild's (1990) study, which combined training carers with providing a regular on-site dental treatment service, showed significant oral health benefits for denture-wearing, although not for dentate, clients. Nicolaci & Tesini (1982) found that dentate mentally handicapped clients showed a steady improvement in periodontal health after carers had been trained in oral health care. In contrast, Schou *et al.*(1989) found that when carers were included in a denture hygiene programme in nursing homes, they performed no better than clients. The possibility of cultural influences in this latter study must be considered, since it took place in Scotland, a country with comparatively poor oral health.

The present study has been designed to bring together many of the separate parameters reported in other studies. The chosen combination of population samples - nursing home carers and residents - has been reported in only two previous studies, which had narrower clinical parameters and did not measure carers' knowledge levels or attitudes. Schou *et al.* (1989) chose as their outcomes reported denture hygiene behaviour, denture hygiene and denture-induced stomatitis; Vigild (1990) reported levels of denture hygiene, denture-induced stomatitis, dental plaque, calculus, gingival

bleeding, and caries. In the present study, as well as the key clinical outcomes of clients' oral health status, which performed the function of indicators of carers' behaviour, carers' oral health knowledge and attitudes have also been measured.

Chapter 3

METHOD

3.1 The study design

The study was a cluster randomised controlled trial, the unit of randomisation being a nursing home with the respective clients and carers. It was a pragmatic study, as discussed in Section 6.1.3, with an extended follow-up of two randomly allocated groups of carers and clients. The intervention group received oral health care education while the control group received none.

Care assistants' oral health knowledge and attitudes were assessed before and after the oral health care education programme. It was also essential to assess whether the health education resulted in carers changing their practice of oral health care for dependent clients. For this reason, the clients' oral health was measured before and after the carers received the intervention. Outcome measures of the intervention group were compared with those of the control group.

In order that the control group homes should not be disadvantaged from achieving the full oral health potential for their clients, the health education programme was presented to their staff after all data collection for the study had been completed. At the end of the study, a summary of the findings was sent to all participating homes.

A diagrammatic representation of the study design is shown in Table 3.1. The researcher visited homes on a rolling schedule, the health promotion sessions being incorporated into the schedule by the Health Promoter. Each round of data collection visits took three months, the first round being immediately followed by the second round. The third round of visits was scheduled so that each home was visited five months after the second visit. The entire clinical trial took twelve months to complete.

Table 3.1: Plan of study design: sequence of events for individual homes

	Intervention group	**Control group**
Week 1	Baseline data collection	
Week 7	Randomisation of homes	
Week 8	Initial visit by Health Promoter to homes to meet qualified staff and, in intervention group homes, to arrange schedule of health education sessions	
Week 10	Oral health education for carers	
Week 14	First follow-up (visit 2) four weeks after OHE Data collection repeated	
Week 34	Second follow-up (visit 3) six months after OHE Data collection repeated	
After completion of all data collection from all homes		Oral health education for carers
At end of data analysis	Feedback	Feedback

3.1.1 Sample size calculations

Statistical advice was given by the University of Bristol Department of Social Medicine. Client sample size calculations were based on target improvements in denture plaque and dental plaque levels, while carer sample size calculations were based on target improvement in oral health knowledge levels.

For denture plaque, assuming a baseline score of 3 on a 0-4 scale, an improvement of 0.6 or more (equivalent to a 20% reduction over assumed baseline levels) was considered clinically relevant; there being no similar data available from other studies,

a plausible standard deviation of mean denture plaque score was estimated to be in the order of 1.2. Thus, the standardised difference was calculated as 0.5. In order to have 80% power to detect a target difference of 0.6, assuming a standard deviation of 1.2 (2-tailed p = 0.05), a sample size of 120 was required. In practice, 331 denture wearers were examined, which increased to 99% the power to detect the same change. This increase in power compensated, at least in part, for the reduction in power resulting from adjusting the analysis to take account of cluster randomisation.

Similarly, for dental plaque, assuming a baseline score of 2 on a 0-3 scale, an improvement of 0.4 over baseline levels was considered clinically relevant; based on a standard deviation of around 1.3 on a 0-6 scale in the study by Nicolaci & Tesini (1982), a plausible standard deviation of mean dental plaque score on the 0-3 scale was estimated to be in the order of 0.6. Thus, the standardised difference was calculated as 0.7. In order to have 80% power to detect a target difference of 0.4, assuming a standard deviation of 0.6 (2 tailed p = 0.05), a sample size of 65 was required. In practice, 118 dentate subjects were examined, which increased to 97% the power to detect the same change, thus compensating, at least in part, for the loss of in power resulting from adjusting the analysis to take account of cluster randomisation.

Among the carers, the one-hour health education session was expected to produce a target improvement in total knowledge scores over baseline levels of around 2.6 (equivalent to 10% of the total possible score of 26); this was considered a relevant change in the light of the 30% improvement achieved after 6 hours training by Glassman *et al.* (1994). A plausible standard deviation was estimated to be in the order of 4.0. Thus, the standardised difference was calculated as 0.65. In order to have 80% power to detect a target difference of 2.6, assuming a standard deviation of 4.0 (2 tailed p = 0.05), a sample size of 80 was required. In practice, all carers of the client sample were included in the study, in order to allow for loss of subjects due to staff turnover during the trial period. Thus, 295 carers were sampled, which increased to over 99% the power to detect the same change.

3.1.2 Inclusion and exclusion criteria

3.1.2.1 Nursing homes

Nursing homes were selected from those in the 20-40 bed range, situated in the Avon Health Authority area and designated for elderly people with sickness, injury or infirmity. Seventy per cent of the 96 nursing homes for frail elderly in Avon fell into this size range. Assuming that not all residents would be both suitable and consenting, it was estimated that a sample of 20 homes in this size range would yield approximately 400 clients. By referring to the Health Authority's list of care establishments, nursing homes were excluded if the number of occupied beds fell outside the specified range, if they were designated as homes for elderly mentally infirm or for people with learning disabilities, psychiatric problems or terminal illness. The 68 eligible homes, which were all privately owned, were numbered in the order they appeared on the Health Authority's list and then randomly selected using a random number table.

3.1.2.2 Clients

Inclusion criteria for clients were that they had at least one natural standing tooth and/or wore dentures; that they could give informed consent; and that they were well enough to participate in the study. Clients were excluded if they were edentulous but did not wear dentures, if they were too cognitively impaired to give informed consent or if their general health was very poor. Between visits, due to normal turnover within homes, some subjects were lost from the trial. Where possible, newly admitted clients were recruited in their place. Thus, some clients were not resident at the time of the intervention, although the data they contributed formed part of the overall picture of oral health within the homes at the particular time points at which they were examined.

3.1.2.3 Care assistants

Because of uncertainty about the possibility of high staff turnover affecting sample size, all care assistants working in participating homes at each of the time points in the study were included in the sample, rather than the minimum number indicated by the

power calculation. Some carers were not present at all the time points in the trial, because they had either left or joined the homes after the baseline questionnaire had been distributed. However, data from all carers responding to questionnaires were included in the analysis.

3.1.3 Blinding

The study was single-blind. It was impossible to blind nursing home staff to their allocation group, since they could not fail to know if their home had received the health education programme. However, it was unlikely that the clients would be aware of health education taking place, or that its effects were being measured; the information they had been given about the study had merely explained that their oral health would be measured on three occasions, in order to see if any changes occurred during the period of the trial.

Most importantly, the researcher, who would be collecting the data, would remain blind to control/intervention group allocations. Several safeguards were employed to maintain the researcher's blindness:

- Random allocation was performed secretly by the researcher's adviser and communicated directly to the Health Promoter.
- The code was kept in a secure place, and was not broken until the end of the study.
- Homes in both groups were visited at the outset by the Health Promoter, so that if anyone in a home subsequently remarked that they had met her, it would still not indicate to which group the home belonged.
- The Health Promoter specifically asked staff not to divulge any information relating to allocation to the researcher. The researcher also reminded matrons of the need to safeguard allocation information each time another examination visit was arranged.

3.1.4 Employment of single examiner

In view of the large number of subjects to be scored for various indices on three occasions, a decision had to be made as to how many examiners should be involved. The decision to employ a single examiner was based on three factors: (i) the availability of additional clinicians; (ii) the appreciation of the need for examiner standardisation through training; (iii) the appreciation that inter-examiner variation tends to be higher than intra-examiner variation (Llewelyn & Addy, 1979).

3.2 The conduct of the study

1. Ethics Committee approval for the study was obtained from the NHS Trusts comprising the area covered by Avon Health Authority, namely Frenchay Healthcare Trust, Southmead Healthcare Trust and United Bristol Healthcare and Weston NHS Trust. The study was also supported informally by Avon Health Authority's Nursing Home Registration and Inspection Department.

2. From the list of nursing homes registered with Avon Health Authority, establishments in the 20-40 bed range were numbered sequentially as they appeared on the list, then selected by the researcher using a table of random numbers.

3. Homes were contacted by telephone in the order in which they had been randomly selected. The researcher identified herself to the matron or proprietor, outlined the research, including how data collection would affect the home, and invited them to participate in the study. Matrons who agreed to participate were sent a letter of confirmation, repeating a brief study outline and promising an initial visit to be arranged shortly.

4. The researcher visited each nursing home by appointment to obtain verbal informed consent from clients fulfilling inclusion criteria. The nature and frequency of the proposed clinical examinations was explained, clients were reassured that no treatment would take place and that they were free to withdraw

from the trial without reason at any time. Any queries were answered. Clients who agreed to take part were given a printed information sheet for reference.

5. Visits were arranged with each home, approximately 1 week after clients' informed consent had been obtained. The researcher, assisted by a specially trained dental nurse, collected baseline data using the measuring instruments detailed below in Section 3.3.

6. At the conclusion of the clinical examination visit, named and numbered questionnaires were distributed to all care assistants. A completion date was indicated, after which matrons were requested to return the questionnaires to the researcher in a pre-paid envelope. A reminder and another copy of the questionnaire were sent to non-responders.

7. Randomisation of homes was carried out while baseline data collection was in progress. To maintain the researcher's blindness, randomisation was performed by her research adviser, using random numbers with a block size of 4. The randomisation code was passed directly to the Health Promoter, who kept the code in a secure location, concealed from the researcher.

8. The Health Promoter made an introductory visit to all homes, explaining to homes in the control group that they would not receive oral health care education until the end of the trial. In order to aid blinding, all homes were asked to conceal from the researcher any indication of whether oral health education had taken place.

9. For the intervention group, a schedule of oral health care education sessions was arranged by the Health Promoter who visited each home to present the oral health education session to carers in small groups. Programme assessment forms were completed by participants and the presenter, who also recorded her time spent travelling and working at each home.

10. The Health Promoter prepared a schedule for the researcher's second round of clinical examinations. The schedule covered the entire sample of homes from both groups, and was arranged so that homes in the intervention group were examined 4 weeks after the health education had taken place.

11. The researcher carried out the second round of clinical data collection and questionnaire administration in an identical manner to the baseline visit.

12. A further 5 months after each home's second visit, clinical examinations and questionnaire administration were repeated for the final time.

13. After all data collection had been completed, data were entered on a computer database (SPSS for Windows).

14. The allocation code was broken and data were analysed using SPSS for Windows and Minitab.

3.2.1 Piloting

The clinical inspection methods, scoring protocol and carers' questionnaire were pre-tested in 2 nursing homes not selected for the main study. Modification and retesting, using a further 3 homes not selected for the main study, were carried out until the clinical scoring and the questionnaire wording were judged satisfactory. The Health Promoter and the researcher pre-tested the oral health care education programme in these 5 homes outside the main study sample.

3.2.2 Confidentiality

Complete confidentiality was maintained for carers completing the questionnaire. Pre-testing revealed that carers were particularly concerned about the nursing home management reading their replies. Therefore, in the main study, detachable named identification slips were stapled to each questionnaire, enabling each carer to receive the form bearing her personal identification number. Anonymity within the home was assured since respondents tore off the name-slip and also sealed their questionnaires in provided envelopes before returning them to matron, who was responsible for the return mailing.

3.3 Clinical examination and scoring

Prior to the study, the researcher was trained in recording methods by the internationally recognised Clinical Trials Unit at Bristol Dental Hospital.

Within the nursing homes, clinical examinations took place between 2pm and 5pm. Examination times were standardised to this 3 hour period in order that diurnal variations in outcome measures would be minimised and that, at each visit, a similar time was likely to have elapsed since any routine daily personal hygiene, which might include oral health care, had been performed.

Clients were brought singly to a private room. If ambulant, they were examined in an armchair, otherwise in a wheelchair. If bed-bound or difficult for staff to move, they were examined in their rooms. In these varied situations, the most practical and effective method of intraoral illumination was a high intensity pocket torch with a focused beam (Mini-Maglite™, Mag Instruments, Ontario, USA). Plane mouth mirrors and probes were used, as necessary, for intraoral examination. Scores were dictated by the researcher and were entered on a scoring form by the dental nurse. A copy of the scoring form appears in Appendix 1.

The prime areas of interest, denture plaque and denture-induced stomatitis, dental plaque and gingivitis, were measured for severity. Indices for outcomes of secondary interest used binary scoring systems. The methods of data collection were as follows:

3.3.1. Demographic data

The client's age, sex and degree of mobility were recorded, together with his/her report of whether help with oral care was needed and/or given, the approximate interval since their last dental attendance, whether a dental check-up had been suggested by the nursing home and whether they were experiencing any current dental problem.

3.3.2. Deposits on dentures

Each denture was removed from the mouth, and the presence or absence of loose debris and/or calculus was recorded.

3.3.3. Denture plaque

Denture plaque was scored according to the method of Augsburger & Elahi (1982), adapted to include lower as well as upper dentures, and partial as well as complete dentures:

- The denture was rinsed free of loose debris in running water, immersed for 30 seconds in a two-tone disclosing solution (Plaque Finder™, Pro-Dentec, Batesville, USA) which has been formulated by the manufacturers to stain plaque differentially; FD&C Red #3 dye stains recent plaque deposits and FD&C Blue #1 dye stains older plaque deposits. The denture was removed from the solution and rinsed in gently running water to remove excess dye.
- Plaque disclosed by the blue dye was scored. Each denture surface was divided into 4 segments (right posterior, right anterior, left anterior and left posterior) and scored on the buccal and mucosal (fitting) surfaces (up to 8 segments per denture) as follows:

  0 = No plaque

  1 = Light plaque (1-25% of area covered)

  2 = Moderate plaque (26-50% of area covered)

  3 = Heavy plaque (51-75% of area covered)

  4 = Very heavy plaque (76-100% of area covered)
- The denture was thoroughly cleaned by immersing in a beaker containing a 2% solution of an ammonia-based denture cleanser (Microsept™, Minerva Dental Limited, Cardiff, UK) and agitating in an ultrasonic bath for 5 minutes.
- After discarding the cleansing solution and thoroughly rinsing the denture, any residual staining was removed by brushing with toothpaste and a single-use toothbrush.

3.3.4. Denture-induced stomatitis

The denture-bearing mucosa of both jaws was examined. The condition of the mucosa was scored according to the grading of Budtz-Jørgensen (1978):

0 = No inflammation

1 = Localised inflammation or pin-point hyperaemia

2 = Diffuse erythema

3 = Inflammatory papillary hyperplasia

The remaining measurements were carried out only on clients with one or more natural teeth.

3.3.5. Dental plaque

The index chosen was based on Greene & Vermillion's (1964) 4 point scale, and was modified to include use of disclosing solution and to score all teeth present, rather than selected teeth:

- The subject rinsed the mouth with water to remove loose debris.
- Plaque disclosing solution containing 1.5% D&C red #28 (Red-Cote®, Butler Company, Chicago, USA) was applied to all teeth using a cotton bud. The mouth was rinsed with water to remove excess dye.
- The teeth were scored as:

  0 = No plaque present

  1 = Plaque covering not more than one-third of tooth surface

  2 = Plaque covering more than one-third but less than two-thirds of tooth surface

  3 = Plaque covering more than two-thirds of tooth surface

  (Restored surfaces were excluded, as were fractured surfaces where a significant proportion of tooth surface had been lost.)
- The researcher removed residual dye from the client's teeth using toothpaste and a single-use toothbrush.

3.3.6. Gingivitis

Gingivitis was scored for severity. Following the method of O'Leary (1967), each jaw was divided into 3 segments (right and left posterior segments incorporating premolar and molar teeth, and anterior segment incorporating canine and incisor teeth). All segments containing at least one tooth were scored. O'Leary's (1967) method was, however, modified to score buccal and lingual surfaces separately. Thus, up to 12 segments per patient could be scored. The score for each segment was the highest score found on any single tooth in that segment. The scoring categories were taken from the three point scale used by Suomi & Barbano (1968):

0 = No inflammation

1 = Presence of inflammation with colour change and perhaps swelling or loss of stippling

2 = Severe inflammation spreading to attached gingiva

3.3.7. Calculus

Visible calculus was scored as present or absent on buccal and lingual surfaces of each tooth. Gentle probing was used as confirmation where necessary. Surfaces with oblique fractures extending subgingivally were excluded.

3.3.8. Cervical/root caries

To improve reliability, lesions were scored after removal of plaque, as recommended by Mojon *et al.* (1995). All teeth were scored and lesions detected by gentle probing were recorded. Lesions recorded as positive met the criteria of Banting *et al.* (1980), being discrete, softened areas indicating decay, located around the cemento-enamel junction. To minimise the time taken to examine clients where loss of periodontal attachment could not readily be ascertained, any lesion in the area of the cervical margin was included. Surfaces with oblique fractures extending subgingivally were excluded.

3.3.9. Tooth mobility

Using gentle mirror handle pressure, mobility of 1mm or more was scored as present or absent on all teeth.

3.4 Care assistants' questionnaires

The researcher attended a course on questionnaire design at the University of Bristol Department of Education and was advised on the compilation of the questionnaire by the course tutor and by the Patient Survey Unit of United Bristol Healthcare Trust. The questionnaire was prepared, piloted and revised using accepted general principles of writing questions and planning questionnaires (Oppenheim, 1992).

The questionnaire was distributed to carers by the matron, and was designed for ease of completion within approximately 20 minutes. It began with non-threatening general questions about the clients. The main questions were separated into topically related sections. The areas covered were knowledge of denture care and care of dentate clients, attitudes to clients' oral care and attitudes to carers' own oral health. Knowledge and attitude questions were closed, requiring a response box to be ticked. Tick boxes for knowledge questions were 'true', 'false' and 'don't know'; attitude statements were measured on a 5 point Likert scale. Finally there were personal questions about carers and their work experience. After each section of the questionnaire, there were open-ended questions to allow carers freedom to express their own feelings about the topics on which they had answered questions. The questionnaire, a copy of which appears in Appendix 2, was printed in booklet form and was self-administered. It explained how the home had been randomly selected and gave explicit assurance of complete confidentiality. Completed questionnaires were sealed in envelopes, collected by the matron and returned to the researcher.

3.5 The oral health education session

The results of qualitative studies of carers' perceptions of oral care (Fiske & Lloyd, 1992; Weeks & Fiske, 1994) were taken into consideration when developing, in collaboration with the Health Promoter, a health education session to meet carers' specific needs. The session was a combination of discussion about carers' experiences of their own and clients' oral care, the giving of information about the relationship between oral health and oral disease, demonstrations of cleaning techniques for dentures and natural teeth, and the opportunity for participants to practice these techniques on teaching models. Emphasis was placed on the importance of the carers' role in clients' personal oral care and the improvement they could make to the clients' comfort and quality of life.

Teaching aids were specially prepared for the programme, including large laminated colour illustrations, acrylic resin models with partial dentures on which carers could practise removal and insertion, denture cleansing materials and dentures with which to practise denture hygiene, and a dentate manikin head with stretchable vinyl skin and cheeks on which simulated brushing of clients' teeth could be rehearsed. Illustrations of these materials appear in Appendix 3.

A booklet was prepared following, where available, current scientifically based health education advice (Levine, 1996) and covering the same aspects of clients' oral health care as the OHE sessions. The booklet had a readability score of 75% on the Flesch Reading Ease test and was professionally printed in A5 format. It was given to all participants to keep for reference and was also referred to as a teaching aid during the oral health education session. Sufficient copies were left at each home for distribution to carers who had been unable to attend the health education sessions. A copy of the leaflet's contents is shown in Appendix 4.

The health education sessions lasted approximately 60 minutes and were presented by the Health Promoter to small groups in the nursing home. The Health Promoter returned to homes to present further sessions until as many staff as possible had been

reached. A standardised plan (Table 3.2) was followed to ensure that core information was conveyed, and that all participants practised oral health care procedures with the teaching models and aids. Participants were given printed and signed certificates, inscribed with their names, to certify their attendance. They were also asked to complete an assessment form for the session. The Health Promoter also completed her own assessment of the session, together with details of the time spent travelling and at the home. Copies of these items appear in Appendix 5.

Table 3.2: Lesson plan for oral health education session

Time	Content	Method	Aids
10 mins	**Introduction**		
	Overview of session		
	Personal feelings and perceptions of oral health	Group	Flip-chart
	Barriers to maintaining good oral hygiene	discussion	Pens
	Oral health care for clients		
5 mins	What do staff currently do for clients?	Group	
	The importance of good oral hygiene and how it affects clients' quality of life	discussion	
10 mins	What causes dental disease?	Talk	Pictures
	Description and identification of plaque		Slides
	How plaque affects clients with natural teeth		Booklet
	How plaque affects clients with dentures		
	Diet and caries		
25 mins	How to remove plaque		
	Toothbrushing	Demonstration	Manikin
	Carers practise brushing on manikin head	Participation	Gloves
	Denture removal and cleaning	Demonstration	Toothbrushes
	Carers practise removal of partial dentures from models and practise denture brushing	Participation	Models
10 mins	**Conclusion and feedback**		
	Recommendation for routine dental check-ups for clients	Short talk	
	Question and answer session, to include fears or problems with clients' oral health care	Discussion	
	Evaluation of session	Questionnaire	

3.6 Statistical methods

In this cluster-randomised controlled trial, the unit of randomisation was the nursing home, within which the carers were the recipients of the health education intervention. The carers and the clients in their care were the source of the main outcome measures. Statistical advice on analyses of the data was given by the Department of Social Medicine, University of Bristol and the Department of Medical Computing and Statistics, University of Wales College of Medicine, Cardiff.

3.6.1 Clinical data analysis

Clinical data were first analysed without hypothesis testing to produce descriptive statistics for intervention and control groups for each variable at each time point in the trial. Baseline data were compared informally to check comparability between allocation groups and to identify whether randomisation had produced comparable groups. Analysis of baseline data was confined to testing cross-sectionally the relationship between denture cleanliness and denture-induced stomatitis levels, using the Spearman rank correlation test. Informal comparison of descriptive data (proportions, means or medians) from different time points provided a useful impression of the overall standards of oral health care pertaining in the homes at the different stages of the trial.

Secondly, the main analyses of the trial were performed to assess the effectiveness of the intervention. These analyses compared each outcome variable at each of the response times (visits 2 and 3) between the intervention and control groups, adjusting for any chance baseline imbalance. Subjects included in these analyses were those who had contributed data both at baseline and at the relevant response visit. The effectiveness of the intervention was assessed using analysis of covariance to adjust group means and give point and confidence interval estimates as well as significance levels. Where distributions were markedly non-Gaussian, a non-parametric approach, the Mann-Whitney test, was employed to compare increments from baseline between the two groups.

Finally, analysis adjusting for cluster randomisation was performed, using the method of Donner *et al.* (1981). This method refines the analysis of covariance results, and calculates point and confidence interval estimates as well as *p*-values, making allowance for the possibility of variation *between* clusters (in this study, homes) being greater than the expected variation *within* clusters. Conventional statistics programs do not provide the facility for this more complicated type of analysis. The analysis was therefore performed using a computer program specially designed by Dr. Robert Newcombe of the University of Wales College of Medicine (UWCM). Figures derived from previous analyses were fed into the UWCM program - a procedure sometimes known as 'post-processing', which refers to the further analyses that take place after the limits of most statistical software programs have been reached. Details of the sequence of calculations according to the method of Donner *et al.* (1981) appear in Chapter 4, section 4.1.2.

3.6.2 Questionnaire data analysis

Questionnaire data were first analysed to produce descriptive statistics for intervention and control groups for each variable at each time point in the trial. Baseline data were compared informally without hypothesis tests to check comparability between allocation groups and to identify whether randomisation had worked effectively. Analysis of baseline data was performed to identify predictors of knowledge and attitude scores using one-way analysis of variance; where the ratio of variance was significant, the Student-Newman-Keuls test was used to detect significant differences between different categories of carer. Multiple regression was then performed to see which predictor variables acted independently.

Data on responses to knowledge and attitude statements were then analysed to identify any differences between the allocation groups at each point in the trial. For statements where a clear shift in knowledge or attitude occurred, the Chi-squared test of significance was performed. Mean aggregate knowledge and attitude scores were calculated for the groups at each time point, and compared using the independent

samples t-test. These aggregate scores were compared for two different but overlapping sets of carers. One set included subjects likely to have been exposed to the health promotion intervention, that is those who were working at the time of the baseline visit and continued to be employed up to the second (and in some cases also the third) visit. The second set included all carers working at each time point of the trial, and was performed in order to assess any possible residual effect of the intervention on carers who may not have participated in the health education sessions. Data from open-ended questions were quoted and summarised.

3.6.3 Assessment of health education sessions

Data assessing the usefulness of the health education sessions from participants and presenter were analysed to produce descriptive statistics.

3.6.4 Assessment of the costs of the intervention

The costs to the NHS of providing the oral health education programme to the intervention group homes were calculated, health economics advice being given by the Research and Development Support Unit of United Bristol Healthcare Trust. The preparation of teaching aids occurred only once and was calculated as fixed costs. Other items which varied according to the number of OHE visits and the number of participants (the Health Promoter's travelling and presentation time, the cost of her travelling expenses and the materials dispensed to participants) were calculated as variable costs. An estimate was then made of the projected costs of delivering the programme to all nursing homes in the health authority area, assuming a need for annual reinforcement of health education messages. This projected cost was based on an estimated 10 year life of teaching materials, using an annual discount rate of 6% of fixed costs plus an extrapolation of variable costs as an estimate of the cost of delivering the OHE programme to all 96 nursing homes in the area.

Chapter 4

RESULTS:

CLIENTS' ORAL HEALTH

4.1 Introduction

The data from this study were analysed in a number of different ways. First, a baseline survey of the client sample was carried out in order to assess the comparability of the two allocation groups. Secondly, there was a descriptive analysis of intragroup changes in measures of clients' oral health status during the trial. This analysis was carried out on data from all clients examined at each visit. Thirdly, in the most important analysis of the study, the effectiveness of the intervention was assessed in respect of intergroup changes in the main outcome variables. Finally, the results of this analysis were further analysed to adjust for the effect of clustering. These two latter analyses were performed on data from clients who contributed both at baseline and at one or both response visits.

The key outcome variables were concerned with measures of oral hygiene. Effective oral health maintenance is primarily achieved by regular removal of dental and, where appropriate, denture plaque. Plaque levels were the outcomes that carers could most directly influence by their intervention. Since plaque levels may change as soon as effective brushing has been performed, these were outcomes where change could most immediately be identified. Plaque levels were therefore the primary outcomes as well as those closest (proximal) to the aims of the intervention.

Plaque is a major aetiological factor in chronic gingivitis in dentate individuals (Löe et al., 1965) and in denture wearers is strongly associated with denture-induced stomatitis (Budtz-Jørgensen, 1978). Gingivitis and denture-induced stomatitis were therefore considered secondary outcomes. Changes in these two outcomes also depend on time. Gingivitis takes a minimum of one week to resolve in the presence of regular effective plaque removal (Löe et al., 1965) and was therefore considered a proximal outcome. Denture-induced stomatitis takes a minimum of two weeks to resolve, even under ideal therapeutic conditions (Pindborg & Holmstrup, 1996) and was considered an intermediate outcome. The parameters of cervical/root caries, calculus and tooth mobility (as a feature of periodontal disease) were also recorded in this study. However, all three develop over relatively long periods of time. Within this study, they were not

expected to be influenced to a significant degree by the programme, unless professional intervention occurred during the study period. These outcomes were therefore considered to be secondary as well as furthest (distal) from the effects of the intervention. The relative importance of the outcome variables is summarised in Table 4.1.

Table 4.1: Relative importance of outcome variables.

Outcomes	Proximal	Intermediate	Distal
Primary	Denture plaque Dental plaque		
Secondary	Gingivitis	Denture-induced stomatitis	Cervical/root caries Calculus Tooth mobility

4.1.1 Analysis of the efficacy of the intervention with regard to clients' oral health

The analysis of efficacy forms the most important part of the study, and tests the hypothesis that the oral health of clients may be improved after carers have received instruction in appropriate oral health care methods. In this analysis, baseline and follow-up visits were considered together. Changes from baseline to visit 2 were compared between the two allocation groups, restricting the analysis to 376 subjects who contributed data at both visits. Changes from baseline to visit 3 were also compared, restricting the analysis to 317 subjects who contributed data to both these visits. Means and summary statistics were derived for continuous measures. Where a whole-mouth score was appropriate, scores were averaged over all scorable sites to give the proportion of sites that were positive.

In comparing post-intervention differences between the groups, analysis of covariance was used to adjust visit 2 means for any baseline imbalance which occurred despite the random allocation. Randomisation worked effectively and was not subverted in

any way. Nevertheless, analysis of covariance gives greater precision in estimates of effect size. In these analyses, the difference between the intervention group's visit 2 adjusted mean and the control group's visit 2 adjusted mean is calculated, together with a standard error and 95% confidence interval. Since lower scores represent better oral health status, a negative sign for the group coefficient indicates a benefit to the intervention group. For example, in Table 4.14, for clients with data for visits 1 and 2, the group coefficient shows that, for all denture surfaces, the intervention group scored on average 1.14 units lower than the control group.

Analysis of covariance was repeated for visit 3 minus visit 1 differences between the groups. For data with skewed distributions, the non-parametric Mann-Whitney test was substituted, using increments from baseline.

4.1.2 Analysis adjusted for cluster randomisation

As discussed in the statistics methodology (Chapter 3, Section 3.6.1), the issue of cluster randomisation needed to be addressed. Analysis of covariance was performed for all outcome variables, using Minitab's regression facility. A within-homes regression slope was used to calculate the groups' visit 2 means, adjusted for any baseline imbalance in order to achieve greater precision in estimating treatment differences. The analysis was repeated to obtain visit 3 means adjusted for baseline imbalance. These analyses, which appear in Appendix 6, show the within-homes regression slopes and the adjusted means for the main outcome variables, comparing baseline data with those from follow-up visits. The values for the differences in adjusted means between the 2 groups were obtained for each variable by subtracting the control group's adjusted mean from that of the intervention group. Since lower scores represent better oral health status, any benefit to the intervention group appears as a negative value.

The figures for the differences in adjusted means at visit 2 and visit 3 were then fed into a post-processing program which calculated the standard error of those differences, adjusted for the clustering, together with corresponding 95% confidence

intervals and hypothesis tests. Tables 4.15, 4.20, 4.23, 4.26, 4.29 and 4.32 contain the results of these analyses for the main outcome variables, with the exception of denture-induced stomatitis, for which statistical advice indicated that, for this non-Gaussian variable, there was no effective way of adjusting for cluster randomisation on non-parametric analyses of increments.

4.1.3 Recruitment of homes

For reasons that were not apparent from the Health Authority's list, certain homes did not fulfil the inclusion criteria. The two reasons for excluding homes after initial contact were:

(i) the number of residents had fallen below 20 (4 homes)

(ii) although the home was not designated as exclusively caring for the elderly mentally infirm, almost all the clients were cognitively impaired (2 homes).

Twenty-six homes were contacted before 20 suitable ones were found. However, the total number of clients recruited from the first 20 homes was only 373. Two further randomly selected homes were contacted, both of which agreed to participate, and a further 39 subjects recruited from them to bring the sample of clients to the desired size.

4.1.4 Checking for bias in analysis of results

During the trial, the researcher recorded her guesses about the allocation group of each home. These estimates were not verified until the allocation code had been broken at the end of the trial. Ten homes had made no particular impression either way. Of the 12 homes where an estimation was made, 6 guesses proved correct and 6 incorrect. The distribution of estimates was therefore similar to that which might be expected by random guessing. This indicates that blindness was successfully maintained.

4.2 Baseline survey of clients

4.2.1 Rationale for comparison of baseline characteristics

Allocation groups would ideally be similar with regard to features that might affect their prognosis. However, random allocation can lead to chance fluctuations between groups (Altman, 1991). Baseline data on clients were therefore compared informally, without hypothesis tests, to assess the degree of similarity between groups for demographic characteristics and for any variables that could affect the outcome measures.

4.2.2 Baseline comparison of clients

Tables 4.2 to 4.4 show the clients' baseline characteristics with respect to demographic data and the oral health status of denture wearers and dentate subjects. For most parameters, the groups were very similar. However, a few slight imbalances had occurred by chance, mainly among data on demographic characteristics (Table 4.2). The intervention group had slightly higher proportions of females and of subjects who were unable to walk. The majority of subjects had not consulted a dentist for at least 5 years; however, the proportion of intervention group subjects who had seen a dentist within the last year was half that of the control group. The intervention group also had a slightly lower proportion of subjects retaining any natural teeth, and among denture wearers, proportionally fewer claiming to be able to clean their dentures easily. Few imbalances were seen in the clinical data. In the intervention group, a slightly higher proportion of denture deposits was found, while among dentate subjects, the average cervical/root caries score was half that of the control group (Table 4.4).

Table 4.2: Baseline comparison of clients' demographic characteristics

Parameter	Control (C)	Intervention (I)
Number of subjects	211	201
1. Age in years		
Mean age (SD)	84.0 [8.3]	84.9 [8.2]
2. Gender		
Female [%]	160 [75.8%]	163 [81.1%]
Male [%]	51 [24.2%]	38 [18.9%]
3. Mobility		
Ambulant [%]	88 [41.7%]	69 [34.3%]
Chairbound [%]	110 [51.2%]	124 [61.7%]
Bedbound [%]	13 [6.2%]	8 [4.0%]
4. Last dental attendance		
Within last year [%]	36 [17.1%]	18 [9.0%]
Between 1 and 5 years ago [%]	38 [18.0%]	29 [14.4%]
Over 5 years ago [%]	80 [37.9%]	103 [51.2%]
Cannot recall [%]	57 [27.0%]	51 [25.4%]
5. Dental status		
Natural teeth only [%]	42 [19.9%]	39 [19.4%]
Natural teeth + partial denture[s] [%]	26 [12.3%]	11 [5.5%]
Complete dentures [%]	143 [67.8%]	151 [75.1%]
6. Do clients clean their dentures?		
Number of denture wearers	168	162
Easily [%]	37 [22.0%]	22 [13.6%]
With difficulty [%]	16 [9.5%]	16 [9.9%]
Not at all [%]	115 [68.5%]	124 [76.5%]
7. Do staff clean clients' dentures?		
Daily [%]	100 [59.2%]	113 [69.8%]
Occasionally [%]	11 [6.6%]	8 [4.9%]
Never [%]	57 [33.7%]	41 [25.3%]
8. Do clients clean their teeth?		
Number of dentate clients	68	50
Easily [%]	16 [23.5%]	13 [26.0%]
With difficulty [%]	17 [25.0%]	18 [36.0%]
Not at all [%]	35 [51.5%]	19 [38.0%]
9. Do staff clean clients' teeth?		
Daily [%]	0	0
Occasionally [%]	3 [4.4%]	0
Never [%]	65 [95.6%]	50 [100%]

Table 4.3: Baseline comparison of denture wearers' oral status

Parameter	Control (C)	Intervention (I)
10. Deposits on dentures		
Total number of upper dentures	164	158
Upper dentures with soft debris [%]	137 [83.5%]	138 [87.3%]
Upper dentures with calculus[%]	89 [54.3%]	103 [65.2%]
Total number of lower dentures	133	127
Lower dentures with soft debris [%]	78 [58.6%]	82 [64.6%]
Lower dentures with calculus[%]	88 [66.2%]	84 [66.1%]
11. Denture plaque		
Number of denture wearers	169	162
Mean plaque score [SD]	2.80 [0.85]	2.82 [0.86]
12. Denture-induced stomatitis		
Number of subjects	169	162
No stomatitis [%]	117 [69.2%]	104 [64.2%]
Pin-point erythema [%]	23 [13.6%]	32 [19.8%]
Diffuse erythema [%]	24 [14.2%]	24 [14.8%]
Papillary hyperplasia [%]	5 [3.0%]	2 [1.2%]

Table 4.4: Baseline comparison of dentate subjects' oral status

Parameter	Control (C)	Intervention (I)
Number of subjects	68	50
Mean number of teeth	11.4	12.5
13. Dental plaque		
Whole mouth mean score [SD]	2.12 [0.57]	2.13 [0.45]
14. Gingivitis		
Whole mouth mean score [SD]	1.31 [0.54]	1.36 [0.40]
15. Calculus		
Whole mouth median score	0.36	0.33
Inter-quartile range	0.09 - 0.57	0.17 - 0.50
16. Cervical/root caries		
Whole mouth median score	0.09	0.04
Inter-quartile range	0 - 0.38	0 - 0.22
17. Tooth mobility		
Whole mouth median score	0	0
Inter-quartile range	0 - 0.10	0 - 0.08

In terms of general health, the control group was at a slight advantage with higher proportions of subjects who were ambulant, claimed to be able to clean their own dentures, retained some natural teeth and had attended a dentist during the last year. These factors would tend, if anything, to work against the hypothesis, since any significant improvement in the intervention group's oral health might be more difficult to achieve, given their poorer baseline health status. However, the groups were closely balanced for the key outcome variables, denture and dental plaque, and for most of the secondary clinical variables, the only slight imbalance being in cervical/root caries.

To summarise, the oral health status of subjects was generally poor. Mean denture plaque scores of 2.8 represented an average coverage close to the 50-75% range. Approximately 30% of denture wearers exhibited erythematous or hyperplastic denture-induced stomatitis. Mean dental plaque scores of 2.1 represented coverage of one- to two-thirds of all tooth surfaces. Gingivitis scores of around 1.3 represented a level almost midway between the values for marginal gingivitis and severe inflammation. One-third of tooth surfaces had calculus deposits and only 17-19% of subjects were calculus-free. Cervical/root caries was present on 4% of tooth surfaces in the intervention group and 9% of tooth surfaces in the control group.

4.2.3 Analytical findings from baseline survey

Denture-induced stomatitis has a complex aetiology involving several factors, one of which is contamination of the denture surface with yeasts and bacteria (Budtz-Jørgensen, 1978). Data were therefore pooled and then analysed to identify any relationship between stomatitis level and denture hygiene. The summary statistics (Table 4.5) indicate a clear tendency for higher plaque levels in subjects with denture-induced stomatitis.

Table 4.5: Relationship of denture plaque and denture-induced stomatitis.

		Mean denture plaque score [SD]		
Stomatitis level	**No.of subjects**	**All denture surfaces**	**Buccal denture surfaces**	**Mucosal denture surfaces**
0	221	2.67 [0.88]	2.58 [0.94]	2.75 [0.94]
1	55	2.98 [0.80]	2.67 [0.89]	3.29 [0.81]
2	48	3.23 [0.59]	3.06 [0.66]	3.41 [0.65]
3	7	3.13 [0.78]	2.82 [0.89]	3.45 [0.81]

The relationship between denture hygiene and denture-induced stomatitis levels was tested using the Spearman rank correlation, which takes account of the inherent ordering of the four stomatitis categories. The results, based on 331 subjects, are shown in Table 4.6, and show correlations of moderate size which are significantly greater than zero. This is particularly marked in respect of mucosal surfaces, where the level of plaque coverage appears significantly to affect the incidence of denture-induced stomatitis.

Table 4.6: Correlation of denture hygiene to denture-induced stomatitis levels.

Denture plaque levels	**Spearman correlation coefficient**	**p value**
All surfaces	0.25	<0.001
Buccal surfaces	0.15	0.007
Mucosal surfaces	0.33	<0.001

4.3 Descriptive follow-up data on clients: demographic characteristics, dental status and oral health care ability

4.3.1 Tracking of clients

At the time of the baseline visits, there were 736 beds in the sample of nursing homes of which 607 were filled, an occupancy rate of 82.5%. When the study inclusion criteria were applied, 176 residents (29%) were ineligible, the majority due to dementia, the remainder because they possessed neither natural teeth nor dentures. Of 431 residents potentially suitable for the trial, 412 (95.6%) agreed to take part. Data were contributed to all three visits by 76.7% of all baseline subjects, 169 out of 211 (80.1%) in the control group and 147 out of 201 (73.1%) in the intervention group. Between visits some subjects were lost to the trial, mainly due to normal turnover within homes. Where possible, newly admitted clients were recruited in their place. Thus, the descriptive data effectively represent three cross-sections, albeit with considerable overlap. The total number of subjects examined at the second visit was 404 and at the third visit, 372. In total, 1188 examinations were made.

4.3.2 Demographic characteristics

Data on subjects' demographic characteristics are shown in Table 4.7. The mean ages of the allocation groups were similar at all stages of the trial. Approximately 12% of subjects were under 75. All five centenarians survived the 12-month trial, as did 27 out of 32 subjects aged between 95 and 100. New subjects recruited during the trial did not affect the balance between the two groups.

By the end of the trial the proportion of females had risen in both groups, although it was consistently slightly higher in the intervention group than the control group.

Clients' mobility was assessed as they presented for examination. Considerable proportions of both groups were chairbound at each time point in the trial, with between 58% and 73% of subjects being unable to walk easily, even with assistance. Very few were bedbound.

Table 4.7: Data on clients' demographic characteristics

Variable	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No.of subjects	211	201	207	197	192	180
Age						
Mean age (years)	84.0	84.9	84.0	85.4	84.2	84.9
Standard deviation	8.3	8.2	8.6	7.7	8.5	8.5
Range	42-100	51-102	42-100	55-102	42-100	55-102
Gender						
Female % [n]	75.8% *[160]*	81.1% *[163]*	76.3% *[158]*	81.2% *[160]*	78.6% *[151]*	83.3% *[150]*
Male % [n]	24.2% *[51]*	18.9% *[38]*	23.7% *[49]*	18.8% *[37]*	21.4% *[41]*	16.7% *[30]*
Mobility of client						
Ambulant % [n]	41.7% *[88]*	34.3% *[69]*	32.9% *[68]*	26.4% *[52]*	31.8% *[61]*	27.2% *[49]*
Chairbound % [n]	52.1% *[110]*	61.7% *[124]*	60.4% *[125]*	68.5% *[135]*	59.4% *[114]*	64.4% *[116]*
Bedbound % [n]	6.2% *[13]*	4.0% *[8]*	6.8% *[14]*	5.1% *[10]*	8.8% *[17]*	8.3% *[15]*

4.3.3 Dental history

Data on clients' reported dental history are shown in Table 4.8. The proportions remained similar throughout the trial. Consistently more control group subjects claimed to have seen a dentist during the previous year than in the intervention group, although the figure was still less than 20%. Very few subjects had been offered a dental examination since they entered the nursing home, although more than one-fifth indicated that they currently had some problem in their mouths.

Table 4.8: Clients' reported dental history

Variable	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No.of subjects	211	201	207	197	192	180
	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]
Last dental attendance						
Less than 12 months ago	17.1% *[36]*	9.0% *[18]*	16.4% *[34]*	10.7% *[21]*	16.7% *[32]*	8.3% *[15]*
1-5 years ago	18.0% *[38]*	14.4% *[29]*	20.3% *[42]*	15.7% *[31]*	21.9% *[42]*	20.6% *[37]*
Over 5 years ago	37.9% *[80]*	51.2% *[103]*	42.5% *[88]*	51.3% *[101]*	44.3% *[85]*	52.2% *[94]*
Don't know	27.0% *[57]*	25.4% *[51]*	20.8% *[43]*	22.3% *[44]*	17.2% *[33]*	18.9% *[34]*
Offered a dental check-up in home						
Yes	14.2% *[30]*	9.5% *[19]*	10.1% *[21]*	7.6% *[15]*	16.7% *[32]*	6.7% *[12]*
No	69.7% *[147]*	79.6% *[160]*	82.3% *[170]*	86.3% *[170]*	76.6% *[147]*	87.8% *[158]*
Don't know	16.1% *[34]*	10.9% *[22]*	7.7% *[16]*	6.1% *[12]*	6.8% *[13]*	5.6% *[10]*
Client aware of current dental problem						
Yes	20.9% *[44]*	22.9% *[46]*	21.7% *[45]*	19.3% *[38]*	20.8% *[40]*	25.0% *[45]*
No	79.1% *[167]*	77.1% *[155]*	78.8% *[162]*	80.7% *[159]*	79.2% *[152]*	75.0% *[135]*

4.3.4 Dental status

The dental status of clients is shown in Table 4.9. At baseline, one-third of control group subjects and one-quarter of intervention group subjects had one or more natural teeth. By the third visit, the proportion of dentate control group subjects had fallen to the same level as the intervention group. Over 80% of all subjects wore some type of denture, the majority of which were complete dentures.

Table 4.9: Dental status of clients

Variable	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No.of subjects	211	201	207	197	192	180
	% [n]	% [n]	% [n]	% [n]	% [n]	% [n]
Edentate or dentate						
No natural teeth	67.8% *[143]*	75.1% *[151]*	70.0% *[145]*	75.6% *[149]*	73.4% *[141]*	73.3% *[132]*
Some natural teeth	32.2% *[68]*	24.9% *[50]*	30.0% *[62]*	24.4% *[48]*	26.6% *[51]*	26.2% *[48]*
Wearing denture(s)						
No denture	19.9% *[42]*	19.4% *[39]*	18.4% *[38]*	16.8% *[33]*	17.7% *[34]*	19.4% *[35]*
Denture(s)	80.1% *[169]*	80.6% *[162]*	81.6% *[169]*	83.2% *[164]*	82.3% *[158]*	80.6% *[145]*
Dentate status						
Natural teeth only	19.9% *[42]*	19.4% *[39]*	18.4% *[38]*	16.8% *[33]*	17.2% *[33]*	19.4% *[35]*
Natural teeth and partial denture(s)	12.3% *[26]*	5.5% *[11]*	11.6% *[24]*	7.1% *[14]*	9.4% *[18]*	7.2% *[13]*
Edentate & wearing complete denture(s)	67.8% *[143]*	75.1% *[151]*	70.0% *[145]*	76.1% *[150]*	73.4% *[141]*	73.3% *[132]*
Proportion of dentures						
No.of upper dentures	164	158	166	161	154	142
Complete	91.5% *[150]*	96.2% *[152]*	91.6% *[152]*	95.0% *[153]*	94.2% *[145]*	94.4% *[134]*
Partial	8.5% *[14]*	3.8% *[6]*	8.4% *[14]*	5.0% *[8]*	5.8% *[9]*	5.6% *[8]*
No.of lower dentures	133	127	130	131	127	119
Complete	91.0% *[121]*	96.1% *[122]*	92.3% *[120]*	94.7% *[124]*	94.5% *[120]*	95.0% *[113]*
Partial	9.0% *[12]*	3.9% *[5]*	7.7% *[10]*	5.3% *[7]*	5.5% *[7]*	5.0% *[6]*

4.3.5. Clients' personal oral care

Table 4.10 summarises clients' expressed degree of need for help with personal oral care compared to the extent to which that help was forthcoming from carers.

Throughout the trial, the majority of denture wearers had difficulty or were unable to clean their dentures. Control group subjects were twice as likely as intervention group subjects to report they cleaned their own dentures easily, but many of these individuals in both groups were able only to soak, not brush, dentures. Most but not all dependent subjects' dentures were cleaned by staff, and the proportions increased in both allocation groups as the study progressed.

During the trial, there was little overall change in the proportions of individuals in either group who were able to clean their own teeth easily. However, the proportions of those reporting brushing with difficulty increased slightly in the control group and more markedly in the intervention group. The respective proportions of clients unable to brush at all diminished correspondingly.

While the proportions of subjects having their teeth brushed daily by staff increased only slightly during the trial, there was an increase in both groups of subjects receiving occasional help and a corresponding decrease in subjects never receiving help. The magnitude of the changes in the intervention group was twice that of the control group.

Table 4.10: Clients' dependency for personal oral care compared to extent of aid given by carers'

Variable	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No of clients with dentures	169	162	169	164	158	145
Do clients clean their dentures? % [n]						
Easily	22.0% *[37]*	13.6% *[22]*	18.3% *[31]*	7.9% *[13]*	17.7% *[28]*	7.6% *[11]*
With difficulty	9.5% *[16]*	9.9% *[16]*	7.7% *[13]*	4.9% *[8]*	8.9% *[14]*	6.9% *[10]*
No	68.5% *[116]*	76.5% *[124]*	74.0% *[125]*	87.2% *[143]*	73.4% *[116]*	85.5% *[124]*
Do staff clean clients' dentures? % [n]						
Daily	59.2% *[100]*	69.8% *[113]*	68.0% *[115]*	87.8% *[144]*	73.4% *[116]*	84.1% *[122]*
Occasionally	6.6% *[11]*	4.9% *[8]*	5.9% *[10]*	3.7% *[6]*	4.4% *[7]*	4.8% *[7]*
Never	33.7% *[58]*	25.3% *[41]*	26.0% *[44]*	8.5% *[14]*	22.2% *[35]*	11.0% *[16]*
No.of dentate subjects	68	50	62	47	51	48
Do clients clean their own teeth? % [n]						
Easily	23.5% *[16]*	26.0% *[13]*	22.6% *[14]*	23.4% *[11]*	23.5% *[12]*	20.8% *[10]*
With difficulty	25.0% *[17]*	36.0% *[18]*	27.4% *[17]*	42.6% *[20]*	29.4% *[15]*	50.0% *[24]*
No	51.5% *[35]*	38.0% *[19]*	50.0% *[31]*	34.0% *[16]*	47.1% *[24]*	29.2% *[14]*
Do staff clean clients' teeth? % [n]						
Staff brush daily	0	0	3.3% *[2]*	4.3% *[2]*	2.7% *[1]*	4.2% *[2]*
Staff brush occasionally	4.4% *[3]*	0	9.8% *[6]*	19.1% *[9]*	10.8% *[4]*	16.7% *[8]*
Staff never brush	95.6% *[65]*	100% *[50]*	86.9% *[54]*	76.6% *[36]*	86.5% *[46]*	79.1% *[38]*

4.4 Denture plaque and other deposits

4.4.1 Descriptive analysis

Data on denture deposits are shown in Table 4.11. For soft debris, there was little change in the control group, but the intervention group exhibited a reduction in numbers of dentures with debris and a corresponding twofold increase in debris-free dentures, both upper and lower. Data on calculus deposits are less clear-cut. Following recording of baseline data, which were similar in both groups, dentures were cleaned ultrasonically and brushed. This process appears to have removed some calculus deposits, since both groups showed lower calculus levels at subsequent visits. However, the intervention group exhibited a greater improvement, this effect being even more pronounced at visit 3.

Table 4.11: Deposits on dentures

Presence of deposits on dentures	**Baseline visit**		**Visit 2**		**Visit 3**	
	C	**I**	**C**	**I**	**C**	**I**
No.of upper dentures	164	158	166	161	154	142
	% [n]		% [n]		% [n]	
Soft debris present	83.5% *[137]*	87.3% *[138]*	71.7% *[119]*	65.8% *[106]*	82.5% *[127]*	70.4% *[100]*
Calculus present	54.3% *[89]*	65.2% *[103]*	44.0% *[73]*	32.3% *[52]*	49.4% *[76]*	27.5% *[39]*
No.of lower dentures	133	127	130	131	127	119
	% [n]		% [n]		% [n]	
Soft debris present	58.6% *[78]*	64.6% *[82]*	49.2% *[64]*	35.1% *[46]*	51.2% *[65]*	34.5% *[41]*
Calculus present	66.2% *[88]*	66.1% *[84]*	40.8% *[53]*	35.9% *[47]*	41.7% *[53]*	26.9% *[32]*

Data for mean denture plaque scores are shown in Table 4.12, and appear in graphic form in Figures 4.1 to 4.4. Plaque was scored on a 0-4 scale. Mean values were obtained by dividing the aggregated segmental score by the number of segments scored. From similar baseline levels, the control group showed a slight increase while the intervention group showed a marked decrease in denture plaque levels.

Table 4.12: Mean denture plaque scores

Mean denture plaque	**Baseline visit**		**Visit 2**		**Visit 3**	
	C	**I**	**C**	**I**	**C**	**I**
No.of denture wearers	169	162	169	164	158	145
All surfaces						
Mean	2.80	2.82	2.81	1.68	3.09	1.58
SD	0.85	0.86	0.85	0.67	0.84	0.76
Buccal surfaces						
Mean	2.68	2.66	2.65	1.61	2.91	1.50
SD	0.91	0.90	0.92	0.67	0.90	0.78
Mucosal surfaces						
Mean	2.91	2.99	2.98	1.74	3.26	1.67
SD	0.91	0.93	0.89	0.75	0.87	0.84

Figures 4.1 to 4.3 (overleaf) show dotplots for each visit for values of mean denture plaque scores derived, as above, by dividing the aggregated segmental score by the number of segments scored. The baseline distribution in both groups was skewed to the right (higher scores). The control group showed little change at visits 2 and 3. In the intervention group, the distribution became skewed to the left (lower scores).

Figure 4.1: Distribution of mean denture plaque scores [all surfaces] at baseline

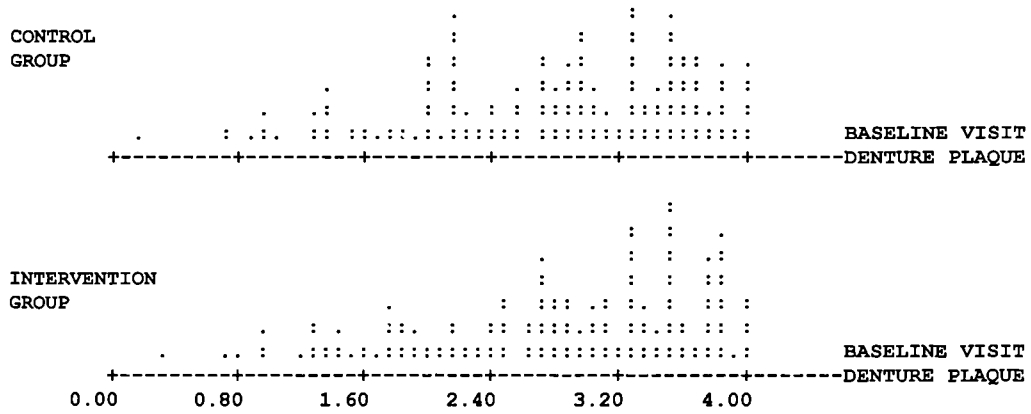


Figure 4.2: Distribution of mean denture plaque scores [all surfaces] at visit 2.

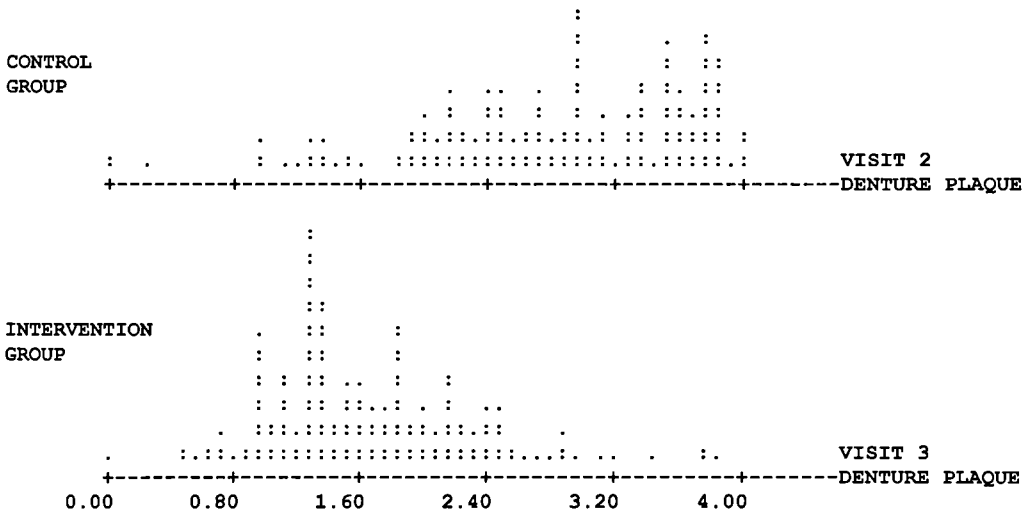


Figure 4.3: Distribution of mean denture plaque scores [all surfaces] at visit 3.

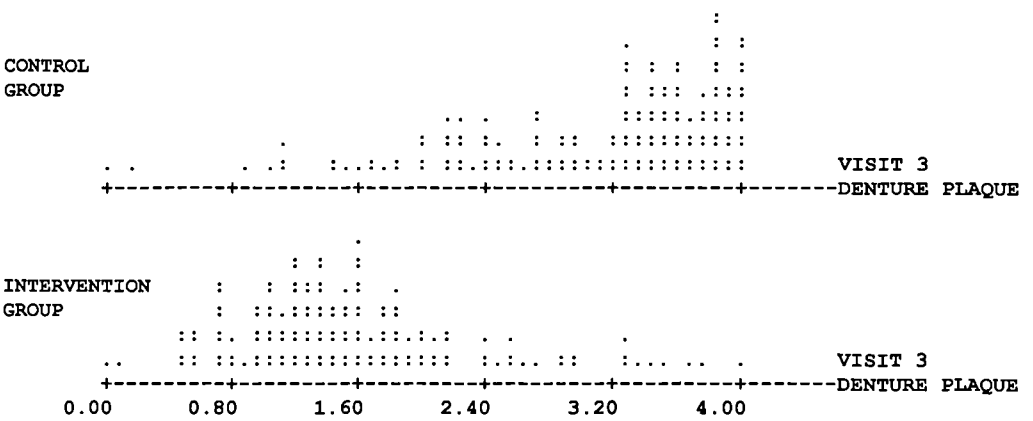


Figure 4.4 represents graphically the groups' mean denture plaque scores for all denture surfaces at each visit.

Figure 4.4: Mean denture plaque scores (all surfaces)
(0-4 scale)

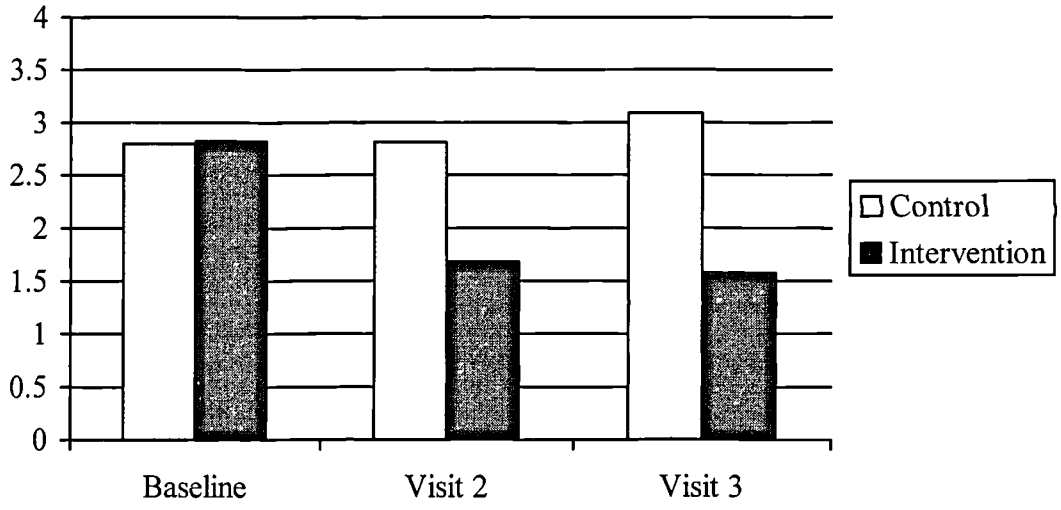


Table 4.13 shows the proportion of dentures that were judged unhygienic (i.e. more than 25% of the total denture surface covered in plaque). While the control group remained at the same very high level, progressively fewer dentures in this category were seen in the intervention group. By the end of the trial, the proportion of unhygienic dentures in the intervention group was 53.6% lower than at baseline.

Table 4.13: Proportions of unhygienic dentures
(>25% denture surfaces covered)

Each cell shows the proportion of unhygienic dentures with, in brackets, the number of unhygienic dentures out of the total number examined.

Group	Visit 1	Visit 2	Visit 3
Control	77.8% [231/297]	79.4% [235/296]	85.8% [241/281]
Intervention	75.8% [216/285]	27.1% [79/292]	22.2% [58/261]

4.4.2 Analysis of the efficacy of the intervention

The analysis of visit 2 minus baseline differences in denture plaque scores was restricted to 162 control and 146 intervention group subjects with data on both visits. The analysis of visit 3 minus baseline differences was restricted to 140 control and 118 intervention group subjects with data on both these visits.

Analysis of covariance was performed on means for denture plaque on all surfaces, and was repeated for plaque on buccal and mucosal surfaces separately. A summary of the results appears in Table 4.14.

For denture plaque on all surfaces and on buccal and mucosal surfaces separately, analysis of covariance showed a benefit to the intervention group in the order of 1 unit at visit 2 and 1.5 units at visit 3. (Each unit represented a 25% increment in plaque coverage.) Both these differences were highly statistically significant ($p<0.001$).

Table 4.14: Comparison of denture plaque scores
(analysis of efficacy of intervention)

- *Reference category - control group*
- *Group coefficient represents treatment difference (negative value indicates benefit to intervention group)*

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
All surfaces								
Number	162	146	162	146	140	118	140	118
Mean	2.83	2.80	2.82	1.66	2.82	2.77	3.09	1.61
SD	0.85	0.88	0.85	0.66	0.86	0.87	0.83	0.79
Analysis of co-variance	Group coefficient -1.14 95% CI -1.28 to -1.01 p value <0.001				Group coefficient -1.46 95% CI -1.64 to -1.29 p value <0.001			
Buccal surfaces								
Number	162	146	162	146	140	118	140	118
Mean	2.71	2.64	2.65	1.60	2.72	2.63	2.92	1.54
SD	0.91	0.90	0.93	0.67	0.92	0.91	0.89	0.82
Analysis of co-variance	Group coefficient -1.02 95% CI -1.16 to -0.88 p value <0.001				Group coefficient -1.34 95% CI -1.53 to -1.16 p value <0.001			
Mucosal surfaces								
Number	162	146	162	146	140	118	140	118
Mean	2.94	2.96	2.99	1.73	2.92	2.92	3.26	1.68
SD	0.90	0.95	0.68	0.67	0.92	0.95	0.85	0.86
Analysis of co-variance	Group coefficient -1.27 95% CI -1.42 to -1.11 p value <0.001				Group coefficient -1.58 95% CI -1.78 to -1.38 p value <0.001			

4.4.3 Analysis adjusting for cluster randomisation

Table 4.15 shows the analysis of data on denture plaque, adjusted for cluster randomisation. Regardless of surface, the differences in group means (Xbar I-C), adjusted for baseline covariate, have a minus sign, indicating that the effect of the intervention was in the direction of an improvement in outcome. At visit 2, the intervention group showed highly significant beneficial effects on denture plaque in the order of 1 unit, or around a 25% increment of denture plaque coverage ($p<0.001$), even after the standard error was increased (about twofold) to allow for the effect of cluster randomisation. The improvement was sustained and even slightly increased at visit 3.

Table 4.15: Analysis allowing for *cluster randomisation: changes in denture* plaque between baseline and visit 2, and between baseline and visit 3

Key
Xbar I-CAdjusted mean difference between intervention group and control group
(negative value indicates benefit to intervention group)
Donner SE Standard error adjusted for cluster randomisation

Variable	Xbar I-C	Crude SE	Donner SE	95% confidence interval lower limit	upper limit	p value
Changes between baseline & visit 2						
All surfaces	-1.15	0.069	0.162	-1.465	-0.826	<0.001
Buccal surfaces	-1.02	0.072	0.156	-1.329	-0.713	<0.001
Mucosal surfaces	-1.27	0.077	0.177	-1.614	-0.917	<0.001
Changes between baseline & visit 3						
All surfaces	-1.47	0.091	0.171	-1.803	-1.127	<0.001
Buccal surfaces	-1.35	0.095	0.170	-1.681	-1.010	<0.001
Mucosal surfaces	-1.58	0.100	0.188	-1.951	-1.211	<0.001

4.5 Denture-induced stomatitis

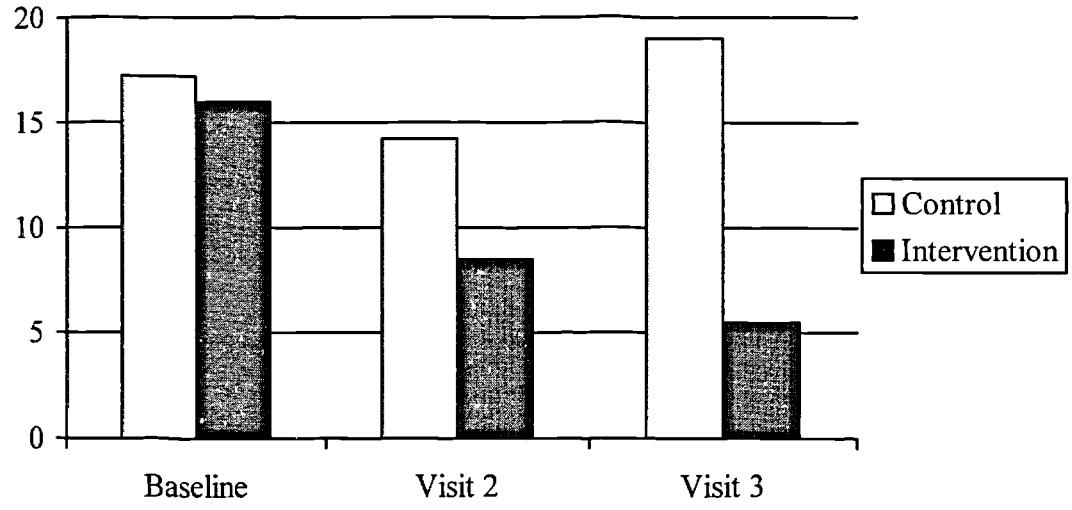
4.5.1 Descriptive analysis

Data on the prevalence of denture-induced stomatitis are shown in Table 4.16. Data on the prevalence of Grades 2 and 3 stomatitis are summarised in graphic form in Figure 4.5. The control group showed little change in any category. In the intervention group, there was a progressive decrease in proportions of subjects in all stomatitis categories and a corresponding increase in subjects with no disease.

Table 4.16: Prevalence of denture-induced stomatitis

Incidence of denture-induced stomatitis	**Baseline visit**		**Visit 2**		**Visit 3**	
	C	**I**	**C**	**I**	**C**	**I**
No of denture wearers	169	162	169	164	158	145
	% [n]		% [n]		% [n]	
Stomatitis not present	69.2% *[117]*	64.2% *[104]*	71.6% *[121]*	79.3% *[130]*	65.2% *[103]*	84.5% *[121]*
Pin-point erythema	13.6% *[23]*	19.8% *[32]*	14.2% *[24]*	12.2% *[20]*	15.8% *[25]*	11.0% *[16]*
Diffuse erythema	14.2% *[24]*	14.8% *[24]*	13.0% *[22]*	7.9% *[13]*	17.1% *[27]*	5.5% *[8]*
Inflammatory papillary hyperplasia	3.0% *[5]*	1.2% *[2]*	1.2% *[2]*	0.6% *[1]*	1.9% *[3]*	0% *[0]*

Figure 4.5: Prevalence of severe denture-induced stomatitis (diffuse erythema & inflammatory papillary hyperplasia) % of affected subjects



4.5.2 Analysis of the efficacy of the intervention

Analysis of differences in denture-induced stomatitis levels between baseline and visit 2 was restricted to 162 control and 146 intervention group subjects with data at both visits, while that between baseline and visit 3 was restricted to 140 control and 118 intervention group subjects with data at both these visits. The data are shown in Table 4.17. Stomatitis had reduced overall at visit 2 in the intervention group compared to the control group ($p<0.03$). This difference was more marked at visit 3 ($p<0.0001$).

Table 4.17: Comparison of denture-induced stomatitis score differences

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
Number	162	146	162	146	140	118	140	118
Stomatitis not present	111	95	116	118	95	76	93	103
Pin-point erythema	22	27	23	17	20	22	22	10
Diffuse erythema	24	22	21	10	20	18	23	5
Inflammatory papillary hyperplasia	5	2	2	1	5	2	2	0
Mann-Whitney test	p value 0.025				p value <0.0001			

4.6 Dental plaque

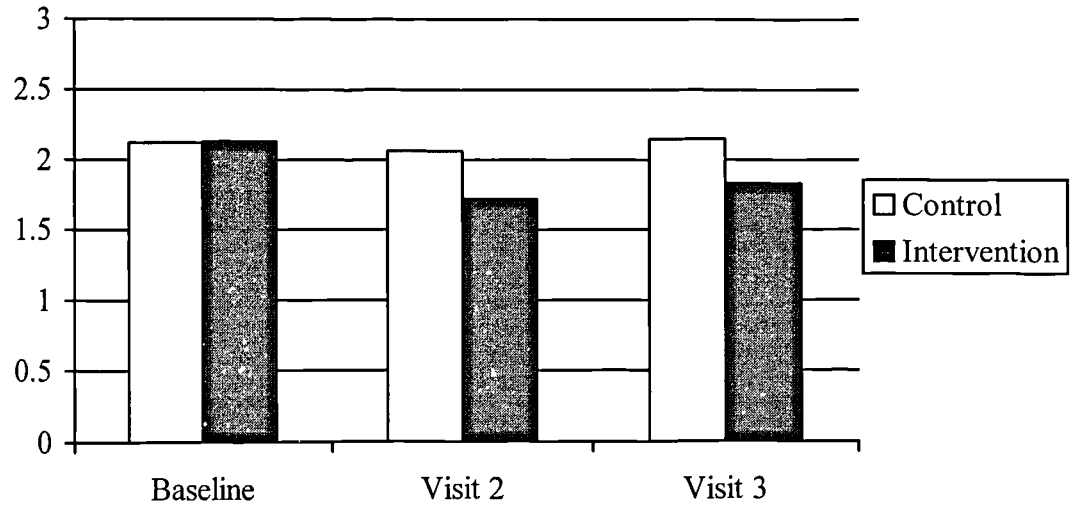
4.6.1 Descriptive analysis

Data on dental plaque scores are shown in Table 4.18 and summarised in graphic form in Figure 4.6. Plaque scores were aggregated and means derived for the whole mouth and for buccal and lingual surfaces separately by averaging the aggregate score over the number of surfaces scored. Since plaque was scored on a 0-3 scale, the mean represents an average rather than a proportion of positive sites. Both groups showed a reduction in plaque levels at visit 2 followed by an increase at visit 3. However, while the control group returned to baseline levels by the end of the trial, the intervention group only exhibited a slight relapse from visit 2 levels.

Table 4.18 : Mean aggregate dental plaque scores

Mean aggregate plaque scores	**Baseline visit**		***Visit 2***		***Visit 3***	
	C	**I**	**C**	**I**	**C**	**I**
No. of dentate subjects	68	50	62	48	51	48
All tooth surfaces						
No. of subjects scored	66	50	61	47	50	47
Mean	2.12	2.13	2.06	1.72	2.15	1.83
SD	0.57	0.45	0.57	0.41	0.54	0.50
Buccal surfaces						
No. of subjects scored	66	50	61	47	50	47
Mean	2.36	2.41	2.22	2.01	2.41	2.17
SD	0.66	0.53	0.63	0.57	0.60	0.63
Lingual surfaces						
No. of subjects scored	65	50	61	47	50	47
Mean	1.87	1.85	1.90	1.44	1.90	1.50
SD	0.73	0.61	0.73	0.51	0.68	0.51

Figure 4.6: Mean dental plaque scores (all surfaces)
(0-3 scale)



4.6.2 Analysis of the efficacy of the intervention

The analysis of visit 2 minus baseline differences in dental plaque scores was restricted to 57 control and 40 intervention group subjects with data on both visits. The analysis of visit 3 minus baseline differences was restricted to 41 control and 37 intervention group subjects with data on both these visits. Analysis of covariance was performed for plaque on all tooth surfaces, and was repeated for plaque on buccal and mucosal surfaces. A summary of the results appears in Table 4.19.

For all parameters, there were benefits for the intervention group. These treatment differences were marginally greater at visit 2 than at visit 3. For dental plaque on all surfaces, analysis of covariance showed that there was a highly significant additional reduction in plaque ($p \leq 0.001$) in the intervention group of 0.42 units at visit 2 and 0.34 units at visit 3. There was also a highly significant difference ($p < 0.001$) in favour of the intervention group regarding lingual plaque of 0.61 units at visits 2 and 0.48 units at visit 3. The reduction in buccal plaque in the intervention group was less marked, being marginally significant ($p = 0.03$) at visit 2, but no longer significant at the 5% level by visit 3 ($p = 0.09$).

Table 4.19: Comparison of dental plaque scores

- *Reference category - control group*
- *Group coefficient represents adjusted treatment difference (negative value indicates benefit to intervention group)*

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
All surfaces								
Number	57	40	57	40	41	37	41	37
Mean	2.12	2.16	2.08	1.69	2.10	2.15	2.18	1.87
SD	0.55	0.48	0.56	0.38	0.54	0.49	0.53	0.49
Analysis of co-variance	Group coefficient -0.42 95% CI -0.58 to -0.25 p value <0.001				Group coefficient -0.34 95% CI -0.53 to -0.15 p value 0.001			
Buccal surfaces								
Number	57	40	57	40	41	37	41	37
Mean	2.36	2.38	2.23	2.00	2.39	2.35	2.45	2.23
SD	0.66	0.55	0.64	0.57	0.64	0.56	0.57	0.63
Analysis of co-variance	Group coefficient -0.24 95% CI -0.45 to -0.03 p value 0.03				Group coefficient -0.20 95% CI -0.42 to 0.03 p value 0.09			
Lingual surfaces								
Number	57	40	57	40	40	37	40	37
Mean	1.88	1.94	1.95	1.37	1.82	1.95	1.93	1.51
SD	0.73	0.61	0.69	0.46	0.74	0.63	0.68	0.49
Analysis of co-variance	Group coefficient -0.61 95% CI -0.81 to -0.40 p value <0.001				Group coefficient -0.48 95% CI -0.71 to -0.25 p value <0.001			

4.6.3 Analysis adjusting for cluster randomisation

Table 4.20 shows the analysis of data on dental plaque, adjusted for cluster randomisation. Irrespective of surface, the differences in means between intervention and control groups (Xbar I-C), adjusted for baseline covariate, have a minus sign, indicating that the effect of the intervention was in the direction of an improvement in outcome. At visit 2, there was a marked beneficial effect on plaque in the intervention group of the order of 0.4 units overall ($p<0.001$), or around 20% on baseline plaque index. The improvement was most marked on lingual surfaces (0.6 units, $p<0.001$) but for buccal surfaces, was not significant at the 5% level. At visit 3, the largely maintained improvement was highly significant for lingual surfaces and for overall plaque ($p<0.001$), but on buccal surfaces did not reach significance at the 5% level.

Table 4.20: Analysis allowing for cluster randomisation: changes in dental plaque between baseline and visit 2, and between baseline and visit 3

Key
Xbar I-CAdjusted mean difference between intervention group and control group
(negative value indicates benefit to intervention group)
Donner SE Standard error adjusted for cluster randomisation

Variable	Xbar I-C	Crude SE	Donner SE	95% confidence interval lower limit	upper limit	p value
Changes between baseline & visit 2						
All surfaces	-0.41	0.082	0.118	-0.648	-0.179	<0.001
Buccal surfaces	-0.24	0.111	0.131	-0.495	0.025	0.076
Lingual surfaces	-0.61	0.098	0.116	-0.840	-0.380	<0.001
Changes between baseline & visit 3						
All surfaces	-0.34	0.097	0.096	-0.526	-0.143	<0.001
Buccal surfaces	-0.20	0.117	0.109	-0.416	0.018	0.072
Lingual surfaces	-0.48	0.116	0.110	-0.701	-0.262	<0.001

4.7 Gingivitis

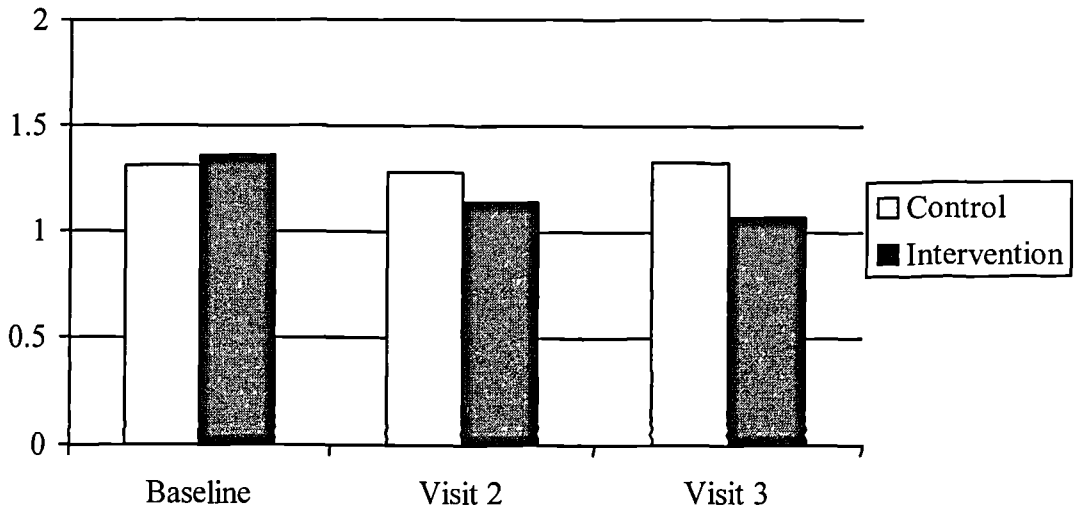
4.7.1 Descriptive analysis

Segmental scores for dentate subjects, using a categorical 0-2 scale, were aggregated and means derived for buccal and lingual surfaces, anterior and posterior segments, both separately and in combination. Numerical data on all combinations of gingivitis scores are shown in Table 4.21 and summarised graphically in Figure 4.7. There were no changes in any set of segments or surfaces for the control group. The intervention group showed progressive reductions in gingivitis scores, the same pattern being exhibited irrespective of segment or surface.

Table 4.21: Mean gingivitis scores

Mean gingivitis scores	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
All segments						
No. of dentate subjects	68	50	62	48	51	48
Mean	1.31	1.36	1.28	1.14	1.33	1.07
SD	0.54	0.40	0.44	0.42	0.34	0.35
Anterior segments						
No. of dentate subjects	67	50	61	47	50	46
Mean	1.34	1.42	1.36	1.18	1.39	1.12
SD	0.58	0.44	0.50	0.47	0.40	0.39
Posterior segments						
No. of dentate subjects	56	39	50	34	44	36
Mean	1.35	1.26	1.28	1.08	1.31	1.03
SD	0.51	0.38	0.45	0.36	0.38	0.35
Buccal surfaces						
No. of dentate subjects	68	50	62	48	51	48
Mean	1.43	1.49	1.42	1.30	1.39	1.20
SD	0.57	0.44	0.48	0.45	0.39	0.42
Lingual surfaces						
No. of dentate subjects	68	50	62	48	51	48
Mean	1.19	1.24	1.14	0.98	1.27	0.95
SD	0.62	0.46	0.50	0.50	0.39	0.40

Figure 4.7: Mean gingivitis scores (all segments)
(0-2 scale)



4.7.2 Analysis of the efficacy of the intervention

Analysis of visit 2 minus baseline differences for gingivitis scores was restricted to 59 control and 41 intervention group subjects with data for both visits. Analysis of visit 3 minus baseline differences was restricted to 42 control and 37 intervention group subjects with data for both these visits. Analysis of covariance was performed for gingivitis on all surfaces, and was repeated for plaque on buccal and mucosal surfaces and for anterior (incisor and canine region) and posterior (premolar and molar region) segments. Summaries of the results appear in Table 4.22.

The small treatment differences in favour of the intervention group seen at visit 2 had all increased in magnitude by visit 3. The differences at visit 2 were barely significant for all surfaces ($p = 0.03$), anterior segments ($p = 0.02$) and lingual surfaces ($p = 0.02$). However, by visit 3, the differences for these parameters had become highly significant ($p \leq 0.001$). Although at visit 2, the treatment differences for posterior segments and buccal surfaces were not significant at the 5% level ($p = 0.12$ and 0.14 respectively), the greater improvements achieved by visit 3 had become highly significant ($p = 0.003$ and 0.001 respectively).

Table 4.22: Comparison of gingivitis scores

- *Reference category - control group*
- *Group coefficient represents adjusted treatment difference (negative value indicates benefit to intervention group)*

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
All segments								
Number	59	41	59	41	42	37	42	37
Mean	1.34	1.34	1.30	1.12	1.38	1.37	1.36	1.08
SD	0.49	0.41	0.43	0.42	0.51	0.41	0.35	0.37
Analysis of co-variance	Group coefficient -0.17 95% CI -0.32 to -0.02 p value 0.026				Group coefficient -0.28 95% CI -0.42 to -0.15 p value <0.001			
Anterior segments								
Number	58	40	58	40	41	36	41	36
Mean	1.38	1.39	1.38	1.16	1.45	1.41	1.43	1.15
SD	0.53	0.45	0.49	0.48	0.53	0.44	0.40	0.39
Analysis of co-variance	Group coefficient 0.08 95% CI -0.40 to -0.05 p value 0.015				Group coefficient -0.27 95% CI -0.42 to -0.12 p value 0.001			
Posterior segments								
Number	49	30	49	30	35	27	35	27
Mean	1.36	1.23	1.27	1.07	1.43	1.24	1.36	1.01
SD	0.47	0.36	0.44	0.36	0.48	0.36	0.40	0.32
Analysis of co-variance	Group coefficient -0.13 95% CI -0.34 to +0.03 p value 0.12				Group coefficient -0.27 95% CI -0.44 to -0.10 p value 0.003			
Buccal surfaces								
Number	59	41	59	41	42	37	42	37
Mean	1.47	1.45	1.43	1.30	1.47	1.48	1.43	1.17
SD	0.52	0.45	0.48	0.46	0.55	0.45	0.40	0.40
Analysis of co-variance	Group coefficient -0.12 95% CI -0.28 to +0.04 p value 0.14				Group coefficient -0.27 95% CI -0.41 to -0.12 p value 0.001			
Lingual surfaces								
Number	59	41	59	41	42	37	42	37
Mean	1.22	1.23	1.16	0.94	1.28	1.25	1.30	0.99
SD	0.56	0.47	0.48	0.49	0.58	0.48	0.41	0.40
Analysis of co-variance	Group coefficient -0.23 95% CI -0.40 to -0.05 p value 0.015				Group coefficient -0.30 95% CI -0.46 to -0.14 p value <0.001			

4.7.3 Analysis adjusting for cluster randomisation

Table 4.23 shows the analysis of gingivitis data, adjusted for cluster randomisation. Regardless of surface or segment, the differences in group means (Xbar I-C), adjusted for baseline covariate, have a minus sign, indicating that the effect of the intervention was in the direction of an improvement in outcome. At visit 2, the effect was marginal, failing to reach significance at the 5% level. At visit 3, the benefit to the intervention group was clear. The benefit was highly significant for all surfaces and for anterior segments ($p<0.001$) and for lingual surfaces and posterior segments ($p = 0.001$). For buccal surfaces, the benefit was moderately significant ($p = 0.002$).

Table 4.23: Analysis allowing for cluster randomisation: changes in gingivitis between baseline and visit 2, and between baseline and visit 3

Key
Xbar I-CAdjusted mean difference between intervention group and control group (negative value indicates benefit to intervention group)
Donner SE Standard error adjusted for cluster randomisation
Anterior segments Includes incisor and canine regions
Posterior segments Includes premolar and molar regions

Variable	Xbar I-C	Crude SE	Donner SE	95% confidence interval lower limit	upper limit	p value
Changes between baseline & visit 2						
All surfaces	-0.17	0.076	0.090	-0.352	0.005	0.057
Anterior segments	-0.22	0.087	0.114	-0.449	0.003	0.055
Posterior segments	-0.13	0.074	0.092	-0.314	0.054	0.160
Buccal surfaces	-0.12	0.079	0.099	-0.319	0.075	0.220
Lingual surfaces	-0.23	0.092	0.105	-0.434	-0.017	0.035
Changes between baseline & visit 3						
All surfaces	-0.28	0.068	0.067	-0.415	-0.148	<0.001
Anterior segments	-0.27	0.074	0.064	-0.393	-0.140	<0.001
Posterior segments	-0.30	0.081	0.086	-0.470	-0.127	0.001
Buccal surfaces	-0.27	0.077	0.083	-0.436	-0.105	0.002
Lingual surfaces	-0.27	0.082	0.076	-0.426	-0.120	0.001

4.8 Dental calculus

4.8.1 Descriptive analysis

Buccal and lingual tooth surfaces scored 0 or 1 and the aggregate calculus score was averaged over the number of surfaces scored to give a value representing the proportion of positive sites. Mean aggregate scores were derived for buccal and lingual surfaces in combination (to give a whole mouth score) as well as separately. These data are shown in Table 4.24.

Table 4.24: Calculus scores: proportion of positive sites

Mean aggregate calculus scores	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No. of dentate subjects	68	50	62	48	51	48
All surfaces						
No. of subjects scored	68	50	62	48	51	47
Median	0.36	0.33	0.30	0.28	0.35	0.36
1st quartile	0.09	0.17	0.12	0.09	0.06	0.19
3rd quartile	0.57	0.50	0.50	0.50	0.50	0.50
Buccal surfaces						
No. of subjects scored	68	50	62	48	51	47
Median	0.41	0.36	0.33	0.33	0.40	0.36
1st quartile	0	0.1	0	0.06	0	0.20
3rd quartile	0.71	0.54	0.62	0.50	0.63	0.50
Lingual surfaces						
No. of subjects scored	68	50	62	48	51	47
Median	0.28	0.33	0.18	0.26	0.17	0.33
1st quartile	0	0.06	0	0	0	0
3rd quartile	0.62	0.60	0.50	0.49	0.57	0.50

The distribution was multimodal, and the standard deviations were close to the mean values. The median, first and third quartiles were therefore taken as more useful

measures. The first quartile is the value below which 25% of observations lie. The third quartile is the value below which 75% of observations lie. Together with the median, these values divide the data into 4 equally populated sub-groups. The inter-quartile range between the first and third quartiles describes the variability of the data.

Neither group showed any overall pattern of change. There was little difference in scores between buccal and lingual surfaces.

4.8.2 Analysis of the efficacy of the intervention

The analysis of visit 2 minus baseline differences in whole-mouth calculus scores was restricted to 59 control and 41 intervention group subjects with data on both visits. The analysis of visit 3 minus baseline differences was restricted to 42 control and 37 intervention group subjects with data on both these visits. The distribution was multimodal, with large standard deviations compared to the means. Therefore the median, first quartile (Q1) and third quartiles (Q3) are reported. Comparison of differences in medians was performed using the Mann-Whitney test.

Summary statistics are shown in Table 4.25. The analyses showed no significant differences at the 5% level between the two groups.

4.8.3 Analysis adjusting for cluster randomisation

Table 4.26 shows the analysis of data on calculus, adjusted for cluster randomisation. There was little evidence of any benefit from the intervention for this outcome. For all surfaces at visit 2 and at visit 3, the 95% confidence interval runs from a negative value (favouring intervention) to a positive value (disfavouring intervention). None of the analyses reached significance at the 5% level.

Table 4.25: Comparison of calculus scores

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
Number	59	41	59	41	42	37	42	37
Whole mouth								
Median	0.35	0.33	0.31	0.28	0.34	0.33	0.34	0.36
Q1	0.08	0.17	0.13	0.08	0	0.24	0.10	0.20
Q3	0.53	0.50	0.50	0.47	0.60	0.55	0.50	0.48
Mann Whitney test	p value 0.42				p value 0.56			
Buccal surfaces								
Median	0.38	0.33	0.36	0.33	0.40	0.40	0.39	0.36
Q1	0	0.15	0	0.06	0	0.17	0	0.23
Q3	0.68	0.56	0.65	0.47	0.73	0.59	0.63	0.45
Mann Whitney test	p value 0.32				p value 0.57			
Lingual surfaces								
Median	0.27	0.33	0.18	0.25	0.21	0.33	0.19	0.33
Q1	0	0.09	0	0	0	0.11	0	0.17
Q3	0.60	0.60	0.50	0.41	0.54	0.60	0.51	0.53
Mann Whitney test	p value 0.87				p value 0.52			

Table 4.26: Analysis allowing for cluster randomisation: changes in calculus between baseline and visit 2, and between baseline and visit 3

Key

Xbar I-C — Adjusted mean difference between intervention group and control group (negative value indicates benefit to intervention group)

Donner SE — Standard error adjusted for cluster randomisation

Variable	Xbar I-C	Crude SE	Donner SE	95% confidence interval lower limit	95% confidence interval upper limit	p value
Changes between baseline & visit 2						
All surfaces	-0.032	0.045	0.052	-0.134	0.071	0.55
Buccal surfaces	-0.083	0.053	0.058	-0.199	0.033	0.16
Lingual surfaces	-0.007	0.046	0.051	-0.107	0.094	0.89
Changes between baseline & visit 3						
All surfaces	0.008	0.037	0.040	-0.074	0.089	0.85
Buccal surfaces	-0.006	0.048	0.053	-0.113	0.100	0.91
Lingual surfaces	0.024	0.042	0.039	-0.054	0.102	0.54

4.9. Cervical and root caries

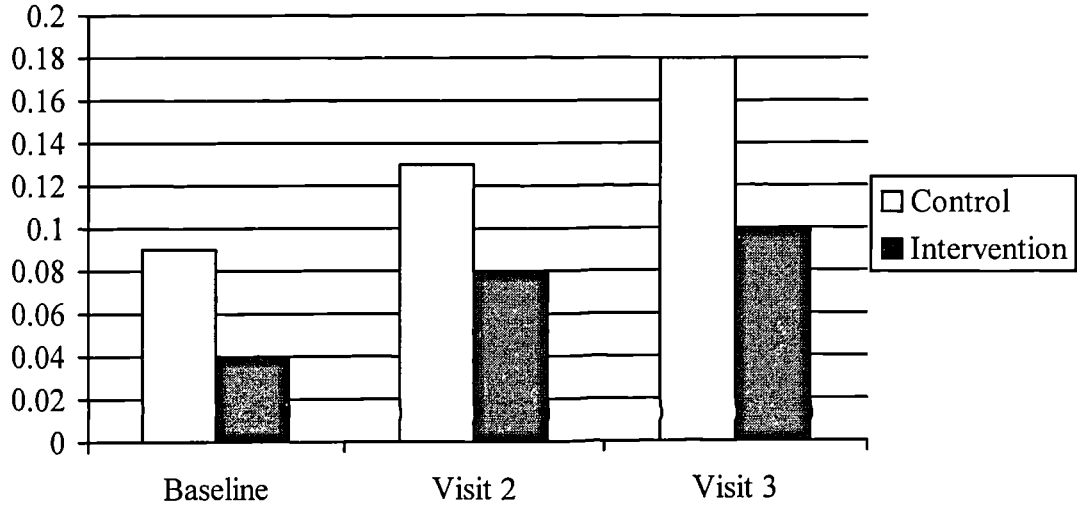
4.9.1 Descriptive analysis

Data on cervical/root caries are shown in Table 4.27 and summarised graphically in Figure 4.8. Each assessable buccal and lingual site scored 0 or 1, and the aggregate score was averaged over the number of tooth surfaces scored to give a value representing the proportion of positive sites. The distribution was grossly skewed with more than half the scores clustered at zero and a large standard deviation in relation to the mean. The median values were therefore compared. The first and third quartiles are also reported. Both groups showed a small progressive increase over the trial period, the control group scores remaining marginally higher. Most of the increase was due to buccal surface scores.

Table 4.27: Cervical/root caries scores: proportion of positive sites

Median average cervical/root caries scores	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No. of dentate subjects	68	50	62	48	51	48
All surfaces						
Median	0.09	0.04	0.13	0.08	0.18	0.10
1st quartile	0	0	0	0	0.04	0
3rd quartile	0.38	0.22	0.38	0.25	0.50	0.31
Buccal surfaces						
Median	0.11	0.07	0.13	0.09	0.25	0.10
1st quartile	0	0	0	0	0.06	0
3rd quartile	0.49	0.29	0.50	0.32	0.67	0.40
Lingual surfaces						
Median	0	0	0.02	0	0.09	0.03
1st quartile	0	0	0	0	0	0
3rd quartile	0.25	0.21	0.25	0.20	0.40	0.16

Figure 4.8: Proportion of surfaces affected by cervical/root caries



4.9.2 Analysis of the efficacy of the intervention

The analysis of visit 2 minus baseline differences in whole-mouth cervical and root caries scores was restricted to 59 control and 41 intervention group subjects with data on both visits. The analysis of visit 3 minus baseline differences was restricted to 42 control and 37 intervention group subjects with data on both these visits. The distribution was skewed, with large standards deviations compared to the means. Therefore the median, first quartile (Q1) and third quartile (Q3) are reported. Comparison of differences in medians was performed using the Mann-Whitney test.

Summary statistics are shown in Table 4.28. The analyses showed no significant differences at the 5% level between the two groups.

Table 4.28: Comparison of cervical/root caries scores (whole mouth)

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
Number	59	41	59	41	42	37	42	37
Median	0.09	0.04	0.13	0.08	0.14	0.04	0.25	0.11
Q1	0	0	0	0	0.02	0	0.08	0
Q3	0.38	0.20	0.38	0.25	0.44	0.24	0.63	0.29
Mann Whitney test	p value 0.91				p value 0.21			

4.9.3 Analysis adjusting for cluster randomisation

Table 4.29 shows the analysis of data on cervical/root caries, adjusted for cluster randomisation. There was little evidence of any benefit from the intervention for cervical/root caries. For all surfaces at visit 2 and at visit 3, the 95% confidence interval runs from a negative value (favouring intervention) to a positive value (disfavouring intervention). None of the analyses reached significance at the 5% level.

Table 4.29: Analysis allowing for cluster randomisation: changes in cervical/root caries between baseline and visit 2, and between baseline and visit 3

Key
Xbar I-CAdjusted mean difference between intervention group and control group
(negative value indicates benefit to intervention group)
Donner SE Standard error adjusted for cluster randomisation

Variable	Xbar I-C	Crude SE	Donner SE	95% confidence interval lower limit	upper limit	p value
Changes between baseline & visit 2						
All surfaces	0.021	0.033	0.040	-0.058	0.100	0.60
Buccal surfaces	0.031	0.035	0.043	-0.054	0.116	0.47
Lingual surfaces	-0.021	0.031	0.036	-0.093	0.050	0.56
Changes between baseline & visit 3						
All surfaces	-0.024	0.032	0.033	-0.089	0.042	0.47
Buccal surfaces	-0.034	0.034	0.042	-0.118	0.050	0.43
Lingual surfaces	-0.031	0.043	0.039	-0.108	0.046	0.42

4.10 Tooth mobility

4.10.1 Descriptive analysis

Data on tooth mobility are shown in Table 4.30. Tooth mobility of 1 millimetre or more scored 1, less than 1 millimetre of mobility scored 0. The aggregate score was averaged over the number of teeth scored, thus the final score represents the proportion of affected teeth. The distribution was grossly skewed with more than half the scores clustered at zero and a large standard deviation in relation to the mean. Median values were therefore compared. Very few teeth were mobile and there was little change over time.

Table 4.30: Tooth mobility: proportion of affected teeth

Teeth with >1mm mobility	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
No. of subjects scored	68	50	62	48	51	48
Average of all teeth present						
Median	0	0	0	0	0.11	0
1st quartile	0	0	0	0	0	0
3rd quartile	0.10	0.08	0.19	0.14	0.25	0.24

4.10.2 Analysis of the efficacy of the intervention

The analysis of visit 2 minus baseline differences in tooth mobility scores was restricted to 59 control and 41 intervention group subjects with data on both visits. The analysis of visit 3 minus baseline differences was restricted to 42 control and 37 intervention group subjects with data on both these visits. The distribution was skewed, with large standards deviations compared to the means. Therefore the median, first quartile (Q1) and third quartile (Q3) are reported. Comparison of differences in medians was performed using the Mann-Whitney test. Summary statistics are shown in Table 4.31. The analysis showed no significant differences at the 5% level between the two groups.

Table 4.31: Comparison of tooth mobility scores (whole mouth)

	Clients with data for visits 1 & 2				Clients with data for visits 1 & 3			
	Visit 1		Visit 2		Visit 1		Visit 3	
	C	I	C	I	C	I	C	I
Number	59	41	59	41	42	37	42	37
Median	0	0	0	0	0	0	0.08	0
Q1	0	0	0	0	0	0	0	0
Q3	0.06	0.08	0.20	0.12	0.09	0.11	0.43	0.23
Mann Whitney test	p value 0.25				p value 0.20			

4.10.3 Analysis adjusting for cluster randomisation

Table 4.32 shows the analysis of data on tooth mobility, adjusted for cluster randomisation. There was little evidence of any benefit from the intervention for tooth mobility. For all surfaces at visit 2 and at visit 3, the 95% confidence interval runs from a negative value (favouring intervention) to a positive value (disfavouring intervention). These analyses did not reach significance at the 5% level.

Table 4.32: Analysis allowing for cluster randomisation: changes in tooth mobility between baseline and visit 2, and between baseline and visit 3.

Key
Xbar I-CAdjusted mean difference between intervention group and control group
(negative value indicates benefit to intervention group)
Donner SE Standard error adjusted for cluster randomisation

Variable	Xbar I-C	Crude SE	Donner SE	95% confidence interval lower limit	upper limit	p value
Tooth mobility visit 1-2	-0.067	0.041	0.046	-0.158	0.024	0.15
Tooth mobility visit 1-3	-0.072	0.043	0.049	-0.170	0.026	0.15

Chapter 5

RESULTS:

CARERS' KNOWLEDGE, ATTITUDES AND ASSESSMENT OF ORAL HEALTH EDUCATION

Introduction

The analyses of carers' data are based on their responses to the questionnaire on oral care for nursing home clients (Appendix 2). First, a baseline survey of the carer sample was carried out, in order to assess the comparability of the two allocation groups. Secondly, there was a descriptive analysis of data concerning carers' demographic characteristics, job experience and dental attendance patterns. Thirdly, carers' responses to individual knowledge questions and attitude statements were compared, and aggregate knowledge and attitude scores calculated. Differences between the allocation groups' scores were compared, and hypothesis tests carried out to identify any effects of the intervention. Fourthly, responses to open-ended questions were compared and summarised. Finally, the results of the carers' and the presenter's assessments of the value of the oral health education were collated, and an estimate was made of the costs of intervention.

5.1 Baseline survey of carers

As with data on clinical subjects, it was necessary to assess the degree of baseline similarity between the two groups of carers, who had been randomly allocated to the study in clusters, according to the nursing home in which they worked. Demographic characteristics, knowledge and attitude scores were compared. Analysis of variance was performed on knowledge and attitude scores to identify any significant heterogeneity within the sample according to age, job experience and dental history.

5.1.1 Baseline comparison of carers

Table 5.1 sets out the baseline characteristics of the allocation groups of nursing home carers in respect of demographic data and of knowledge and attitudes scores calculated from the questionnaire responses. For all parameters, the differences between the groups were very small. No factors were identified which might bias the overall outcome of the study. The groups were therefore considered to be balanced for the purposes of the trial.

Table 5.1: Baseline comparison of carers' demographic characteristics, knowledge and attitude scores

Parameter	Control (C) No.of carers [%]	Intervention (I) No.of carers [%]
1. Age group		
No.of responses	144	150
16-25	46 [31.9%]	39 [26.0%]
26-35	31 [21.5%]	34 [22.7%]
36-45	39 [27.1%]	44 [29.3%]
45-55	24 [16.7%]	25 [16.7%]
Over 55	4 [2.8%]	8 [5.3%]
2. Gender		
No.of responses	144	151
Female [%]	136 [94.4%]	147 [97.4%]
Male [%]	8 [5.6%]	4 [2.6%]
3. Job experience (years)		
No.of responses	144	148
<1 year	24 [16.7%]	18 [9.0%]
1-5 years	68 [47.2%]	79 [53.4%]
6-10 years	39 [27.1%]	39 [26.4%]
10 years	13 [9.0%]	12 [8.1%]
Median [range]	4 [<1-21]	4 [<1-25]
4. Dental attendance pattern		
No.of responses	144	151
Registered with GDP	130 [90.3%]	136 [90.1%]
Attendance pattern		
At least once per year	97 [68.3%]	99 [66.0%]
Only if aware of treatment need	14 [9.9%]	20 [13.3%]
Only if in discomfort	10 [7.0%]	16 [10.7%]
Only if in severe pain	12 [8.5%]	10 [6.7%]
Other	9 [6.3%]	5 [3.3%]
5. Knowledge & attitude scores		
No.of responses	146	151
Mean knowledge score [SD] *Maximum possible score 26*	16.43 [3.55]	16.60 [3.24]
Mean attitude score [SD] *High score = positive attitude Possible range +50 to -50*	17.30 [10.40]	17.52 [10.34]

When the mean knowledge scores were expressed as a percentage of correctly answered questions, the control group had 63.2%, the intervention group 63.8%. The scores indicated a fairly good level of basic oral health knowledge. The groups' overall scores for the 25 attitude statements were 17.30 and 17.52. These give a mildly positive average per question score of 0.7, that is nearer 'tend to agree' than 'no opinion'.

5.1.2 Analytical findings from baseline survey

Questionnaire data were examined to identify possible factors that might be significantly associated with a high or low knowledge or attitude score. The factors hypothesised as being potentially associated with scores were age, job experience and dental attendance pattern. Data from control and intervention groups were pooled for this purpose and then divided into groups according to factor category.

A one-way analysis of variance was performed on knowledge and attitude scores with respect to each of the three factors of interest. The null hypothesis, that the samples came from a population with the same mean and variance, was tested by calculating the ratio of the variance estimated from the means of the groups and the variance between individuals within groups. If the null hypothesis were true and all groups had the same mean, the ratio of variances would be 1. Where the ratio of variance was greater than 1, the p value was obtained by comparing the ratio of variance (F ratio) with the F distribution table, using the between- and within-groups degrees of freedom. Where the p value was significant (<0.05), the Student-Newman-Keuls test was used to detect significant differences between different categories of carer.

An example of the calculation, using the comparison of knowledge scores with age group, is shown in Table 5.2.

Table 5.2: One-way analysis of variance on knowledge score compared to age

The mean knowledge scores for all true/false questions were:

Age group	16-25	26-35	36-45	46-55	Over 55
Mean score	16.45	15.35	17.43	16.88	16.25

Analysis of variance

Source	DF	Sum of squares	Mean squares	F ratio	F probability
Between groups	4	165.05	41.26	3.81	0.005
Within groups	289	3129.77	10.83		
Total	293	3294.33			

The Student-Newman-Keuls test incorporates a conservative assumption because it performs multiple tests of significance; it makes a demanding p value assumption for paired comparisons. Performed on these data, the Student-Newman-Keuls test indicated significant differences between the 26-35 and the 36-45 year age groups. The results of the analyses on all knowledge and attitude parameters appear in Tables 5.3 to 5.8.

5.1.2.1 Factors associated with knowledge scores: univariable analyses

Tables 5.3 to 5.5 show the analysis of factors associated with oral health care knowledge, both for total knowledge scores and for denture and dental care separately. For total knowledge scores (Table 5.3), a significant difference was found between the low-scoring 26-35 age group and the high-scoring 36-45 age group. Despite a p value of <0.05 related to dental attendance patterns, the conservative Student-Newman-Keuls test detected no significant difference between groups. For denture care knowledge (Table 5.4), a significant difference ($p<0.005$) was found between the low-scoring 26-35 age group and all the other groups under 55 years of age. For dental care knowledge (Table 5.5), age and dental attendance pattern predicted a high dental care knowledge score. The 36-45 age group scored significantly higher ($p = 0.02$) than carers aged 16-25 and 26-35. Carers who attended a dentist at least once a year had a significantly higher score ($p = 0.05$) than those with an unspecified attendance pattern.

Table 5.3: Factors affecting total knowledge score
[maximum possible score = 26]

Predictor	Knowledge score [mean]	p value	Significant differences between groups (based on Student-Newman-Keuls test)
Age			
16-25	16.45		26-35
26-35	15.35		*and*
36-45	17.43	<0.005	36-45
46-55	16.88		
Over 55	16.25		
Job experience			
<1 year	16.40		
1-5 years	16.39	0.39	None
6-10 years	17.09		
> 10 years	16.04		
Dental attendance			
At least once a year	16.92		
If aware of treatment need	15.62		
When in discomfort	16.42	<0.05	None
When in severe pain	16.41		
Other	14.64		

Table 5.4: Factors affecting denture care knowledge score
[maximum possible score = 11]

Predictor	Knowledge score [mean]	p value	Significant differences between groups (based on Student-Newman-Keuls test)
Age			
16-25	7.93		
26-35	7.03		26-35
36-45	8.00	<0.005	*and*
46-55	7.98		16-25, 36-45,46-55
Over 55	7.17		
Job experience			
<1 year	7.62		
1-5 years	7.67	0.49	None
6-10 years	7.96		
> 10 years	7.40		
Dental attendance			
At least once a year	7.88		
If aware of treatment need	7.03		
When in discomfort	7.88	0.12	None
When in severe pain	7.59		
Other	7.36		

Table 5.5: Factors affecting dental care knowledge score
[maximum possible score = 15]

Predictor	Knowledge score [mean]	p value	Significant differences between groups (based on Student-Newman-Keuls test)
Age			
16-25	8.52		
26-35	8.32		36-45
36-45	9.43	0.02	*and*
46-55	8.90		16-25, 26-35
Over 55	9.08		
Job experience			
Less than 1 year	8.79		
1-5 years	8.72	0.57	None
6-10 years	9.13		
More than 10 years	8.64		
Dental attendance			
At least once a year	9.04		
If aware of treatment need	8.59		At least once a year
When in discomfort	8.54	0.05	*and*
When in severe pain	8.82		Other
Other	7.29		

5.1.2.2 Factors associated with attitude scores: univariable analyses

Tables 5.6 to 5.8 show the analysis of factors associated with attitude scores, both as a total score and subdivided into attitudes to clients' oral health and carers' own oral health. For total attitude scores (Table 5.6), a significant difference was found between the high-scoring 26-35 age group and the 16-25 and 45-55 age groups. There was also a significant difference between the group attending dentists regularly and those attending only when symptoms prevailed.

For clients' oral health (Table 5.7), there were differences between groups according to age and dental attendance pattern. The highest attitude scores were seen in carers aged between 26 and 45, with that of the 26-35 age group being significantly different ($p = 0.02$) from the lower scoring groups aged 16-25 and 46-55.

Carers attending a dentist at least once a year had significantly higher scores ($p<0.01$) than those in the low-scoring group who only attended with discomfort.

For carers' own oral health (Table 5.8), the only significant difference was found in dental attendance groups. Carers attending a dentist at least once a year had significantly higher scores ($p<0.0001$) than those in groups attending only if treatment need was apparent through discomfort, pain or some other symptom.

Table 5.6: Factors affecting total attitude score
High score = positive attitude Possible range +50 to -50

Predictor	Attitude score [mean]	p value	Significant differences between groups (based on Student-Newman-Keuls test)
Age			
16-25	16.35		26-35
26-35	20.42	0.007	*and*
36-45	18.72		16-25, 46-55
46-55	14.45		
Over 55	13.00		
Job experience			
<1 year	18.31		
1-5 years	16.92	0.7	None
6-10 years	17.37		
> 10 years	19.16		
Dental attendance			
At least once a year	19.37		At least once a year
If aware of treatment need	14.18		*and*
When in discomfort	12.31	0.0003	If aware of treatment need
When in severe pain	13.46		When in discomfort
Other	15.43		When in severe pain

Table 5.7: Factors affecting attitude score for clients' oral health

High score = positive attitude *Possible range +26 to -26*

Predictor	Attitude score [mean]	p value	Significant differences between groups (based on Student-Newman-Keuls test)
Age			
16-25	10.00		
26-35	12.52		26-35
36-45	11.55	0.02	*and*
46-55	8.86		16-25 & 46-55
Over 55	9.08		
Job experience			
<1 year	9.95		
1-5 years	10.71	0.69	None
6-10 years	10.88		
> 10 years	11.92		
Dental attendance			
At least once a year	11.79		
If aware of treatment need	9.21		At least once a year
When in discomfort	8.12	<0.01	*and*
When in severe pain	8.95		When discomfort
Other	9.43		

Table 5.8: Factors affecting attitude score for carers' oral health

High score = positive attitude *Possible range +24 to -24*

Predictor	Attitude score [mean]	p value	Significant differences between groups (based on Student-Newman-Keuls test)
Age			
16-25	6.91		
26-35	7.89		
36-45	7.65	0.07	None
46-55	7.98		
Over 55	7.17		
Job experience			
<1 year	8.36		
1-5 years	6.93	0.33	None
6-10 years	6.54		
> 10 years	7.24		
Dental attendance			
At least once a year	8.07		At least once a year
If aware of treatment need	5.18		*and*
When in discomfort	4.23	<0.0001	If aware of treatment need
When in severe pain	4.50		When in discomfort
Other	6.29		When severe pain

5.1.2.3 Knowledge and attitude predictors: multivariable analysis

Since confounding could be a potential problem between the individual factors affecting knowledge and attitude scores, multiple regression analysis was performed to see if predictor variables acted independently or as confounders. Table 5.9 shows the results from the model examining the effects of age, job experience and dental attendance pattern on total knowledge score. Age and dental attendance pattern emerged as the main predictors, both when acting singly and in the model adjusting for the other variables of interest. In the adjusted model, the combined effect of the predictor variables accounted for 7% of the total variance of the outcome variable.

Table 5.9: Unadjusted and adjusted regression coefficients for predictor variables for total knowledge score (based on pooled baseline data).

* All variables based on model including age, job experience and dental attendance pattern.
A higher score implies a better knowledge score.
Adjusted R-squared for the multiple regression model is 7%.

Predictor variable	Level of variable	Unadjusted regression coefficient	p value	Adjusted regression coefficient* [95% CI]	p value
Age	16-25	Reference	0.005	Reference	0.001
	26-35	-1.09		-1.45 [-2.54, -0.36]	
	36-45	0.99		0.90 [-0.15, 1.94]	
	45-55	0.43		0.36 [-0.85, 1.56]	
	>55	-0.20		0.12 [-2.02, 2.26]	
Job experience	<1 year	Reference	0.4	Reference	0.4
	1-5 years	-0.02		-0.20 [-1.35, 0.95]	
	6-10 years	0.69		0.42 [-0.87, 1.71]	
	>10 years	-0.37		-0.70 [-2.48, 1.07]	
Dental attendance pattern	≥Once a year	Reference	0.05	Reference	0.03
	Aware of need	-1.30		-1.21 [-2.42, -0.01]	
	Discomfort	-0.50		-0.45 [-1.81, 0.90]	
	Pain	-0.50		-0.62 [-2.08, 0.84]	
	Other	-2.28		-2.60 [-4.40, -0.80]	

Multiple regression analysis was repeated for total attitude score, using a model covering the effects of age, job experience and dental attendance pattern. The results are shown in Table 5.10. Age and dental attendance pattern again emerged as the main predictors, both when acting singly and in the model adjusting for the other variables of interest. In the adjusted model, the combined effect of the predictor variables accounted for 7% of the total variance of the outcome variable.

Table 5.10: Unadjusted and adjusted regression coefficients for predictor variables for total attitude score (based on pooled baseline data).

* All variables based on model including age, job experience and dental attendance pattern.
A higher score implies a more positive attitude.
Adjusted R-squared for this model is 7%.

Predictor variable	Level of variable	Unadjusted regression coefficient	p value	Adjusted regression coefficient* [95% CI]	p value
Age	16-25	Reference	0.007	Reference	0.03
	26-35	4.06		2.99 [-0.36, 6.35]	
	36-45	2.37		1.06 [-2.16, 4.28]	
	45-55	-1.90		-2.59 [-6.30, 1.11]	
	>55	-3.35		-3.81 [-10.38, 2.75]	
Job experience	<1 year	Reference	0.7	Reference	0.7
	1-5 years	-1.39		-0.50 [-4.03, 3.02]	
	6-10 years	-0.94		-0.26 [-4.22, 7.39]	
	>10 years	0.85		1.94 [-3.50, 7.39]	
Dental attendance pattern	≥Once a year	Reference	<0.001	Reference	0.002
	Aware of need	-5.20		-4.70 [-8.40, -0.99]	
	Discomfort	-7.06		-6.52 [-10.69, -2.36]	
	Pain	-5.92		-5.57 [-10.05, -1.08]	
	Other	-3.94		-2.76 [-8.30, 2.77]	

Similar models covering the sub-divisions of knowledge and attitude outcome variables tended to show a degree of consistency. In most cases, the regression coefficients for age and dental attendance pattern reached statistical significance at the 5% level (Table 5.11). Exceptions were the coefficients for the effect of dental attendance pattern on denture care knowledge and the adjusted coefficient for the effect of age on carers' attitudes to their own oral health. The regression coefficients for job experience failed to reach statistical significance in any analysis.

Table 5.11: Comparison of p values for unadjusted and adjusted models on score predictors (based on pooled baseline data)

Score	Variable	p value for unadjusted regression coefficient	p value for adjusted regression coefficient
Knowledge scores			
Total score on denture care	Age Total employment Dental attendance pattern	0.005 0.5 0.12	0.002 0.5 0.12
Total score on dental health care	Age Total employment Dental attendance pattern	0.02 0.6 <0.05	0.006 0.6 0.02
Attitude scores			
Attitude score [clients' oral health]	Age Total employment Dental attendance pattern	<0.02 0.7 <0.01	0.05 0.4 <0.03
Attitude score [carers' own oral health]	Age Total employment Dental attendance pattern	<0.07 0.3 <0.001	0.26 0.5 <0.001

5.2 Analysis of data from carers' questionnaires

5.2.1 Tracking of carers

At baseline, 369 carers were working in the sample of homes. Between baseline and visit 2, 65 carers left employment and 18 new staff joined the homes, giving a total of 322 carers at visit 2. Between visits 2 and 3, 62 carers left and 29 began employment, giving a total of 289 carers at visit 3. During the period of the trial, the total number of carers employed for all or part of that time was 416. There were 242 carers who remained in the nursing homes' employment throughout the trial, although 10 of these were absent for part of that time due to maternity leave or extended sick leave.

5.2.2 Response rates and demographic characteristics of carers

Table 5.12 shows response rates and demographic data about carers. Response rates remained around 80%. The age distribution of the carers was similar in both groups with the majority of carers in the 16-45 age group and very few carers over the age of 55. Both groups had a large majority of female carers.

5.2.3 Dental attendance pattern

Both allocation groups reported similar patterns of dental registration and attendance (Table 5.13). Approximately 90% of carers claimed to be registered with a dentist. However, only two-thirds attended at least once a year for examination.

5.2.4 Experience of nursing home work

Carers' work experience was similar in both groups and details are shown in Table 5.14. Approximately half the workforce had 1-5 years' experience and a further quarter had 6-10 years' experience. Initially approximately 12% of the workforce had arrived in the preceding 6 months, but as staff levels fell during the trial, turnover between visits decreased. The proportion of carers having stayed for more than 3 years

increased and the proportion with less than 6 months experience fell to below 4%. More than half the carers worked a day shift, a quarter worked on the night shift while the remainder worked a variety of shifts including all-day shifts lasting 12-14 hours.

Table 5.12: Carers' response rates, age and gender.

Variable	Baseline visit		Visit 2		Visit 3	
	C % [n]	I % [n]	C % [n]	I % [n]	C % [n]	I % [n]
Questionnaire response rate						
Number distributed	171	198	156	166	136	153
Response rate	85.4% [146]	76.3% [151]	82.7% [129]	79.5% [132]	77.9% [106]	76.5% [117]
Overall response rate	80.5%		81.1%		77.2%	
Age group						
No.of responses	144	150	129	132	106	115
16-25 years	31.9% *[46]*	26.0% *[39]*	31% *[40]*	25.0% *[33]*	29.2% *[31]*	32.5% *[31]*
26-35 years	21.5% *[31]*	22.7% *[34]*	19.4% *[25]*	22.7% *[30]*	17.0% *[18]*	19.7% *[23]*
36-45 years	27.1% *[39]*	29.3% *[44]*	31.8% *[41]*	33.3% *[44]*	33.0% *[35]*	29.9% *[35]*
46-55 years	16.7% *[24]*	16.7% *[25]*	14.7% *[19]*	14.4% *[19]*	17.0% *[18]*	18.8% *[22]*
>55 years	2.8% *[4]*	5.3% *[8]*	3.1% *[4]*	3.0% *[4]*	3.8% *[4]*	3.4% *[4]*
Gender						
No.of responses	144	151	128	129	105	108
Female	94.4% *[136]*	97.4% *[147]*	93.8% *[121]*	95.5% *[126]*	97.1% *[102]*	99.1% *[107]*
Male	5.6% *[8]*	2.6% *[4]*	4.9% *[7]*	2.3% *[3]*	2.9% *[3]*	0.9% *[1]*

Table 5.13: Carers' dental attendance pattern

Variable	Baseline visit		Visit 2		Visit 3	
	C % [n]	I % [n]	C % [n]	I % [n]	C % [n]	I % [n]
Registration with dentist						
No.of responses	144	151	129	130	106	115
Registered	90.3% *[130]*	90.1% *[136]*	86.0% *[111]*	87.7% *[114]*	86.8% *[92]*	93.0% *[107]*
Not registered	9.7% *[14]*	9.9% *[15]*	14.0% *[18]*	12.3% *[16]*	13.2% *[14]*	7.0% *[8]*
Dental attendance						
No.of responses	142	150	123	129	101	113
At least once a year	68.3% *[97]*	66.0% *[99]*	65.9% *[81]*	69.0% *[89]*	70.3% *[71]*	69.9% *[79]*
If aware of treatment need	9.9% *[14]*	13.3% *[20]*	13.8% *[17]*	10.1% *[13]*	10.9% *[11]*	8.9% *[10]*
When in discomfort	7.0% *[10]*	10.7% *[16]*	7.3% *[9]*	10.9% *[14]*	10.9% *[11]*	12.4% *[14]*
When in pain	8.5% *[12]*	6.7% *[10]*	8.5% *[11]*	10.1% *[13]*	5.9% *[6]*	7.1% *[8]*
Other	6.3% *[9]*	3.3% *[5]*	4.1% *[5]*	0	2.0% *[2]*	1.8% *[2]*

Table 5.14: Carers' working experience

Variable	Baseline visit		Visit 2		Visit 3	
	C % [n]	I % [n]	C % [n]	I % [n]	C % [n]	I % [n]
Job experience						
No.of responses	144	148	125	127	105	115
<1 year	16.7% *[24]*	12.2% *[18]*	14.4% *[18]*	14.2% *[18]*	8.6% *[9]*	10.4% *[12]*
1-5 years	47.2% *[68]*	53.4% *[79]*	50.4% *[63]*	51.2% *[65]*	54.3% *[57]*	56.4% *[65]*
6-10 years	27.1% *[39]*	26.4% *[39]*	25.6% *[32]*	26.0% *[33]*	23.8% *[25]*	22.6% *[26]*
>10 years	9.0% *[13]*	8.1% *[12]*	9.6% *[12]*	8.7% *[11]*	13.3% *[14]*	10.4%% *[12]*
Mean	4.5	4.7	4.3	4.5	4.9	5.0
SD	4.5	4.4	4.1	4.4	4.2	5.0
Range	<1-21	<1-25	<1-19	<1-21	>1-17	>1-21
Time worked in present home						
No.of responses	143	151	127	127	106	115
<6 months	12.6% *[18]*	10.6% *[16]*	14.2% *[18]*	10.2% *[13]*	3.8% *[4]*	3.5% *[4]*
6-11 months	16.8% *[24]*	13.2% *[20]*	9.4% *[12]*	11.8% *[15]*	9.4% *[10]*	11.3% *[13]*
1-2 years	31.5% *[45]*	30.5% *[46]*	35.4% *[45]*	30.7% *[39]*	42.5% *[45]*	36.5% *[42]*
3 years +	39.2% *[56]*	45.7% *[69]*	40.9% *[52]*	47.2% *[60]*	44.3% *[47]*	48.6% *[56]*
Shifts worked						
No.of responses	143	150	128	129	105	116
Day	51.7% *[74]*	56.0% *[84]*	58.1% *[75]*	50.0% *[66]*	59.0% *[62]*	50.9% *[59]*
Night	26.6% *[38]*	26.7% *[40*	21.1% *[27]*	25.6% *[33]*	21.9% *[23]*	19.8% *[23]*
Various	21.7% *[31]*	17.3% *[26*	20.2% *[26]*	23.3% *[129]*	19.0% *[20]*	29.3% *[34]*

5.3 Comparison of carers' knowledge and attitude responses

First, a descriptive analysis was carried out on the responses to knowledge statements. The proportions of correct responses to each question were examined at baseline to identify areas where knowledge levels were deficient. For many statements, knowledge levels remained at roughly the same level throughout the trial, and therefore, only baseline levels are reported and stand proxy for levels at subsequent visits. However, for a small number of statements, knowledge levels changed and differences between the allocation groups became larger. For this latter group of statements, the pattern of change over follow-up visits is reported.

Next, mean aggregated knowledge scores of carers were compared. These data were described for two different but overlapping bodies of carers. One body was composed of 257 carers who were present at baseline and at the second (and in some cases, also the third) visit; thus in the intervention group, these carers were likely to have been present during health education, even if they did not participate personally, and were therefore likely to have been affected directly or indirectly by the intervention. The second body was composed of all carers responding at each individual time point; this body included, additionally, carers who had joined the homes after baseline; for those carers not employed at baseline but contributing data at visit 2, it was not possible to identify whether they had joined the home before or after the health education. The purpose of analysing data from this second body was to identify whether there might be a residual effect in the homes from the health education intervention, resulting in more recently employed carers being affected by the impact of the intervention on their colleagues.

A similar analysis was then carried out on responses to attitude statements. Where there was little change in proportions of responses over the trial period, only baseline data have been reported. Where attitude changes were of greater magnitude, data from all three time points have been reported using data from all carers responding at each

of those points. Mean aggregated attitude scales for control and intervention groups have then been compared for the 257 carers present at baseline and during the period of the health education, in order to assess any direct effects of the intervention. Comparison of attitude scores has then been repeated for all carers responding at each individual time point, in order to identify whether there might be a residual effect after the intervention, resulting in more recently employed carers being affected by the impact of the intervention within the homes.

5.3.1 Knowledge regarding care of denture-wearing clients

Carers were asked to tick 'true', 'false' or 'don't know' boxes to indicate their opinion of oral health care knowledge statements. Responses were scored as correct or incorrect, the latter category including 'don't know' replies.

The proportion of correct responses to 8 of 11 statements on denture care remained similar throughout the trial. These data are shown in Table 5.15, baseline data alone being reported, since they are typical of data from subsequent time points. With the exception of statement 11, knowledge levels were high in both groups of carers.

For three denture care statements, starting from comparatively low knowledge bases, differences in the proportions of responses between the groups became more marked as the trial progressed. Details of carers' responses to these statements are shown in Table 5.16. The distributions were compared using the Chi squared test. By the end of the trial, correct control group responses to statement 7 increased by around 13%, while the intervention group improved by around 27%; group differences were statistically significant at visit 3 ($p = 0.02$). For statement 8, the intervention group almost doubled its proportion of correct responses by the end of the trial, and group differences were statistically significant at visits 2 and 3 ($p = 0.02$). For statement 10, the intervention group improved by 22%, while the control group remained around the same level as at baseline for both these statements; group differences were highly significant for statement 10 at visit 2 ($p<0.001$) and visit 3 ($p = 0.01$).

Table 5.15:
Responses to knowledge statements on denture care for which correct response rates remained similar at all time points (data from all carers responding at baseline)

Key to statements: Statement numbers refer to numbering in questionnaire
(T denotes true statements, F denotes false statements)

	Statement	Baseline		
		Group	Responses correct/total	% correct
1	Ideally, clients' dentures should be taken out at night. [T]	C I	143/144 149/151	99.3 98.7
2	Denture cleaning solutions remove the dirt from dentures without you needing to brush as well. [F]	C I	129/145 135/151	89.0 89.4
3	Soft food often sticks to dentures but it does not make them uncomfortable to wear. [F]	C I	99/143 116/151	69.2 76.8
4	Bacteria tend not to stick to the surface of dentures. [F]	C I	123/144 123/147	85.4 83.7
5	Unclean dentures can cause mouth infections. [T]	C I	140/145 136/151	96.6 90.1
6	For clients' comfort, dentures should be rinsed after every meal. [T]	C I	129/143 124/150	90.2 82.7
9	A dirty denture may look unsightly but it will not cause any disease in the mouth. [F]	C I	123/143 121/150	86.0 80.7
11	Wearing a denture increases the number of bacteria in the mouth. [T]	C I	64/144 62/151	44.4 41.1

Table 5.16:
Responses to knowledge statements on denture care for which correct response rates changed during the trial
(data from all carers responding at each individual time point in the trial)

Key to statements: Statement numbers refer to numbering in questionnaire
(T denotes true statements, F denotes false statements)
7. Clients without natural teeth only need a dental check-up when they have a problem. [F]
8. Clients usually notice discomfort if they have a gum infection under their dentures. [F]
10. Thorough brushing cleans dentures more effectively than soaking in a denture cleaner. [T]

		Baseline		Visit 2		Visit 3	
State-ment	Group	Responses correct/total	% correct	Responses correct/total	% correct	Responses correct/total	% correct
7	C	89/142	62.7	97/128	75.8	81/106	76.4
	I	91/150	60.7	107/131	81.7	103/117	88.0
p value (X^2, 1df)				0.25		0.02	
8	C	13/142	9.2	14/128	10.9	11/106	10.4
	I	19/151	12.6	29/131	22.1	26/117	22.2
p value (X^2, 1df)				0.02		0.02	
10	C	79/144	54.9	68/126	54.0	61/105	58.1
	I	85/151	56.3	100/129	77.5	91/116	78.4
p value (X^2, 1df)				<0.001		0.01	

5.3.2 Knowledge regarding care of dentate clients

Carers' responses to statements on care of dentate clients were scored either as correct or incorrect (including don't know), as described in Section 5.3.1.

The proportion of correct responses to 12 of 15 statements remained similar throughout the trial. These data are shown in Table 5.17. For these statements, baseline data alone are reported, since they are typical of data from subsequent time points. Wide variation in knowledge levels can be seen, although the proportion of correct responses for individual statements was well balanced between the groups.

Table 5.17:
Responses to knowledge statements on care of dentate clients for which correct response rates remained similar at all time points (data from all carers responding at baseline)

Key to statements: Statement numbers refer to numbering in questionnaire
(T denotes true statements, F denotes false statements)

	Statement	Baseline		
		Group	Responses correct/total	% correct
12	A softer toothbrush is better than a hard one for cleaning clients' teeth. [T]	C I	84/143 90/151	58.7 59.6
14	Lack of calcium can put clients at risk from tooth decay. [F]	C I	5/144 9/142	3.5 6.0
16	Brushing clients' teeth will also improve the condition of their gums. [T]	C I	135/143 142/151	94.4 94.0
17	If clients have a lot of sugary food and drink, their teeth are more likely to decay. [T]	C I	135/144 142/151	93.8 94.0
18	A mouth-swab is a good alternative to a toothbrush for cleaning clients' teeth. [F]	C I	80/143 94/150	55.9 62.7
20	Bacteria in clients' mouths are one of the causes of dental decay [T]	C I	113/144 125/150	78.5 83.3
21	Clients with dry mouths will tend to get less decay. [F]	C I	91/144 92/149	63.2 61.7
22	Even if the gums around the teeth are inflamed or bleeding, they do not usually cause any pain [T]	C I	31/143 32/151	21.7 21.2
23	For health and safety reasons, you should wear protective gloves when cleaning clients' teeth. [T]	C I	128/144 128/151	89.5 84.8
24	Most clients with bad teeth will have inherited a tendency to get decay. [F]	C I	64/144 66/149	44.4 44.3
25	Once gum disease has started, it is almost impossible to halt. [F]	C I	88/143 101/149	61.5 67.8
26	Older people can often get more decay than younger people. [T]	C I	43/144 40/151	29.9 26.5

For three statements on care of dentate clients, differences in the proportions of correct responses between the groups became more marked as the trial progressed. The distributions were compared using the Chi squared test. Details of these data are shown in Table 5.18. For statement 13, the intervention group had improved by around 9% during the trial while the control group showed a poorer result; group differences were statistically significant at visit 2 ($p = 0.04$), although not at visit 3. For statements 15 and 19, the intervention group had improved by around 12% by the end of the trial while the control group remained at baseline level; group differences were statistically significant at visit 3 for both these statements ($p = 0.02$ and $p = 0.03$ respectively).

Table 5.18:
Responses to knowledge statements on care of dentate clients for which correct response rates changed during the trial (data from all carers responding at each individual time point in the trial)

Key to statements: Statement numbers refer to numbering in questionnaire
(T denotes true statements, F denotes false statements)
13. A large-headed toothbrush is less efficient at cleaning teeth than a small-headed one. [T]
15. Old people's teeth are less prone to decay than younger people's teeth. [F]
19. It is possible to catch certain infections from contact with a client's saliva. [T]

		Baseline		Visit 2		Visit 3	
State-ment	Group	Responses correct/total	% correct	Responses correct/total	% correct	Responses correct/total	% correct
13	C	74/143	51.7	48/148	37.5	49/104	47.1
	I	73/149	49.0	65/130	50.0	68/117	58.1
p value (X^2, 1df)				0.04		0.10	
15	C	113/141	80.1	108/129	83.7	86/105	81.9
	I	120/151	79.5	115/131	87.8	108/117	92.3
p value (X^2, 1df)				0.35		0.02	
19	C	83/143	58.0	70/126	55.6	61/104	58.7
	I	91/151	60.3	82/129	63.1	84/116	72.4
p value (X^2, 1df)				0.22		0.03	

5.3.3 Comparison of derived knowledge scores

For carers working both at baseline and during the period of the intervention, comparisons of mean aggregate knowledge scores are shown in Table 5.19. (Visit 2 and visit 3 differences could not be adjusted for baseline differences because it was not possible to link individuals' data accurately, due to variable patterns of response.) The distributions at each sampling time were normal, therefore means were compared using the independent samples t-test. The groups' baseline scores were similar, but at both visits 2 and 3, the intervention group scored higher than the control group for all sets of statements. Intervention group scores were subtracted from control group scores. Differences in mean scores on denture care were statistically significant at visit 2 ($p = 0.01$), although not at visit 3. Differences in mean scores on care of dentate clients were highly significant at visit 2 ($p = 0.008$) and visit 3 ($p < 0.001$). Total knowledge score differences were highly significant at visit 2 ($p = 0.003$) and visit 3 ($p = 0.001$).

Table 5.19: Comparison of knowledge scores
(data from carers employed at baseline and during the intervention period)
* Negative value indicates a benefit to the intervention group

Responses to clients' oral care statements	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
Number of respondents	106	101	113	116	88	95
Denture care [11 statements]						
Mean score	7.69	7.61	8.05	8.63	8.34	8.68
SD	1.81	1.78	1.64	1.76	1.36	1.46
Mean difference (C-I)*	0.08		-0.58		-0.34	
CI for difference	-0.42 to 0.57		-1.02 to -0.13		-0.76 to 0.07	
2-tailed p-value	0.8		0.01		0.10	
Care of dentate clients [15 statements]						
Mean score	8.76	8.91	8.41	9.23	8.81	10.01
SD	2.42	1.86	2.39	2.26	2.22	2.02
Mean difference (C-I)*	-0.15		-0.83		-1.20	
CI for difference	-0.75 to 0.44		-1.43 to -0.22		-1.82 to -0.59	
2-tailed p-value	0.6		0.008		<0.001	
Total knowledge score [26 statements]						
Mean score	16.44	16.53	16.46	17.86	17.15	18.70
SD	3.56	3.03	3.50	3.50	2.94	3.06
Mean difference (C-I)*	-0.09		-1.40		-1.55	
CI for difference	-0.10 to 0.83		-2.31 to -0.49		-2.42 to -0.67	
2-tailed p-value	0.9		0.003		0.001	

For all carers participating at each individual point in the trial, comparison of the mean aggregate knowledge scores, using the independent samples t test, are shown in Table 5.20. (Visit 2 and visit 3 differences were not adjusted for baseline differences, because the groups were composed of different combinations of subjects at different visits.) The groups' baseline scores were similar, but at visits 2 and 3, the intervention group scored higher than the control group for all sets of statements. Differences in means were statistically significant for denture care statements at visit 2 ($p = 0.028$), but not at visit 3. For statements on care of dentate clients, differences in means were highly statistically significant at visit 2 ($p = 0.003$) and at visit 3 ($p<0.001$). For total knowledge scores, the differences were highly significant at visit 2 ($p = 0.002$) and visit 3 ($p = 0.001$).

Table 5.20: Comparison of knowledge scores (data from all carers employed at each individual time point in the trial)

* Negative value indicates a benefit to the intervention group

Responses to statements on clients' oral care	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
Number of respondents	146	151	129	132	106	117
Denture care [11 statements]						
Mean score	7.75	7.69	8.06	8.53	8.36	8.70
SD	1.75	1.84	1.61	1.80	1.40	1.40
Mean difference (C-I)*	0.06		-0.49		-0.34	
CI for difference	-0.35 to 0.47		-0.89 to -0.05		-0.71 to 0.03	
2-tailed p-value	0.8		0.028		0.07	
Care of dentate clients [15 statements]						
Mean score	8.68	8.91	8.36	9.21	8.80	9.84
SD	2.51	1.97	2.34	2.19	2.26	2.09
Mean difference (C-I)*	-0.23		-0.84		-1.04	
CI for difference	-0.74 to 0.29		-1.39 to -0.29		-1.61 to -0.46	
2-tailed p-value	0.4		0.003		<0.001	
Total knowledge score [26 statements]						
Mean score	16.43	16.60	16.43	17.74	17.16	18.54
SD	3.55	3.24	3.44	3.49	3.06	3.06
Mean difference (C-I)*	-0.17		-1.31		-1.38	
CI for difference	-0.95 to 0.61		-2.15 to -0.47		-2.19 to -0.57	
2-tailed p-value	0.7		0.002		0.001	

5.3.4 Attitudes towards clients' oral care

Carers were asked to tick one of five points on a Likert scale to indicate their degree of agreement or disagreement with attitude statements on clients' oral care. 'No opinion' was included in the choice of responses in order to avoid pressurising carers to express an opinion about which they felt uncomfortable or uncertain. However, this option was excluded from the analysis of statement responses, since it was not possible to identify whether 'no opinion' had been selected because the carer was unwilling to answer, lacked the experience to answer, or genuinely felt neutral about the statement.

For 11 of 13 statements, the proportions of each type of response remained similar throughout the trial. These data are shown in Table 5.21, baseline data alone being reported, since they are typical of data from subsequent time points. Both groups showed similar proportions of positive responses (i.e. 'strongly agree' or 'tend to agree' with positively worded statements, 'strongly disagree' or 'tend to disagree' with negatively worded statements).

For two statements on clients' oral health care, differences in proportions of responses between the groups became more marked as the trial progressed. The distributions were compared using the Chi squared test. Details of these data are shown in Table 5.22. For statement 9, the control group showed no change during the trial but the intervention group returned a progressively higher proportion of positive responses, being around 14% higher at visit 3 than at baseline; by visit 3, group differences were statistically significant ($p = 0.02$). For statement 13, the control group's proportion of positive responses fell by around 8% during the trial but the intervention group returned a progressively higher proportion of positive responses, being around 11% higher by the end of the trial than at baseline; by visit 3, group differences were statistically significant ($p = 0.04$).

Table 5.21:
Responses to attitude statements on clients' oral care for which proportions of positive responses remained similar at all time points (data from all carers responding at baseline)

+ denotes positively worded statement, - denotes negatively worded statement

Statement (Numbers refer to numbering in questionnaire)		Response	Baseline	
			C % [n]	I % [n]
1	I see it as my responsibility to keep my clients' natural teeth clean. [+]	Strongly agree	60.3 [85]	67.3 [101]
		Tend to agree	37.6 [53]	32 0 [48]
		Tend to disagree	2.1 [3]	0.7 [1]
		Strongly disagree	0	0
2	I feel more uncomfortable brushing inside a client's mouth than I do with most other kinds of personal care. [-]	Strongly agree	5.1 [7]	13.0 [18]
		Tend to agree	36.0 [49]	37.7 [52]
		Tend to disagree	41.2 [56]	33.3 [46]
		Strongly disagree	17.6 [24]	15.9 [22]
3	I believe I can help in preventing my clients' teeth from becoming decayed. [+]	Strongly agree	32.0 [31]	45.8 [44]
		Tend to agree	57.7 [56]	47.9 [46]
		Tend to disagree	9.3 [9]	4.2 [4]
		Strongly disagree	1.0 [1]	2.1 [2]
4	I think that only the dentist can prevent clients' teeth from decaying. [-]	Strongly agree	2.8 [4]	3.4 [5]
		Tend to agree	8.5 [12]	8.9 [13]
		Tend to disagree	42.6 [60]	37.0 [54]
		Strongly disagree	46.1 [65]	50.7 [74]
5	If clients' gums bleed, I feel I should probably stop brushing their teeth altogether. [-]	Strongly agree	2.1 [3]	3.4 [5]
		Tend to agree	9.9 [14]	9.4 [14]
		Tend to disagree	49.6 [70]	50.3 [75]
		Strongly disagree	38.3 [54]	36.9 [55]
6	Cleaning clients' natural teeth is a task I feel confident to carry out. [+]	Strongly agree	44.4 [59]	40.4 [59]
		Tend to agree	42.1 [56]	48.6 [71]
		Tend to disagree	12.0 [16]	11.0 [16]
		Strongly disagree	1.5 [2]	0
7	I believe I can play a useful part in preventing my clients from getting gum disease. [+]	Strongly agree	40.3 [56]	42.6 [63]
		Tend to agree	51.1 [71]	51.4 [76]
		Tend to disagree	7.2 [10]	5.4 [8]
		Strongly disagree	1.4 [2]	0.7 [1]
8	When I brush clients' natural teeth, I feel I do it competently. [+]	Strongly agree	36.8 [49]	34.0 [48]
		Tend to agree	54.1 [72]	58.9 [83]
		Tend to disagree	8.3 [11]	7.1 [10]
		Strongly disagree	0.8 [1]	0
10	When a client's gums bleed, I think I should step up my brushing efforts. [+]	Strongly agree	9.1 [12]	7.9 [11]
		Tend to agree	15.9 [21]	15.7 [22]
		Tend to disagree	48.5 [64]	48.6 [68]
		Strongly disagree	26.5 [35]	27.9 [39]

Table continued overleaf

Table 5.21 (continued):
Responses to attitude statements on clients' oral care for which proportions of positive responses remained similar at all time points (data from all carers responding at baseline)

+ denotes positively worded statement, - denotes negatively worded statement

Statement (Numbers refer to numbering in questionnaire)		Response	Baseline	
			C % [n]	I % [n]
11	Brushing teeth is a very personal thing that you should not be expected to do for somebody else.[-]	Strongly agree Tend to agree Tend to disagree Strongly disagree	3.6 [5] 8.6 [12] 42.4 [59] 45.3 [63]	2.0 [3] 6.0 [9] 32.7 [49] 59.3 [89]
12	In my opinion, it is better to wait until clients have a problem before asking the dentist to see them. [-]	Strongly agree Tend to agree Tend to disagree Strongly disagree	4.2 [6] 5.6 [8] 43.8 [63] 46.5 [67]	3.4 [5] 4.7 [7] 38.5 [57] 53.4 [79]

Table 5.22:
Responses to attitude statements on clients' oral care for which proportions of positive responses changed during the trial (data from all carers responding at each individual time point)

Key to statements *(Statement numbers refer to numbering in questionnaire)*
+ denotes positively worded statement; - denotes negatively worded statement

9. I think that the dentist is the only person who can help clients who have gum disease. [-]
13. When I brush a client's natural teeth, I feel unsure if I am doing it right. [-]

Statement		Baseline		Visit 2		Visit 3	
No	Response	C % [n]	I % [n]	C % [n]	I % [n]	C % [n]	I % [n]
9	Strongly agree	16.2 [22]	16.3 [24]	18.8 [22]	10.8 [13]	15.0 [15]	10.5 [12]
	Tend to agree	26.5 [36]	22.4 [33]	23.9 [28]	20.8 [25]	27.0 [27]	14.0 [16]
	Tend to disagree	41.2 [56]	40.1 [59]	41.0 [48]	43.3 [52]	40.0 [40]	43.9 [50]
	Strongly disagree	16.2 [22]	21.2 [31]	16.2 [19]	25.0 [30]	18.0 [18]	31.6 [36]
p value (X^2, 3df)		0.65		0.16		0.02	
13	Strongly agree	3.6 [5]	5.4 [8]	3.4 [4]	3.2 [4]	7.4 [7]	1.8 [2]
	Tend to agree	26.3 [36]	29.9 [44]	32.2 [38]	22 6 [28]	30.5 [29]	20.5 [23]
	Tend to disagree	48.9 [67]	44.2 [65]	48.3 [57]	45.2 [56]	36.8 [35]	50.9 [57]
	Strongly disagree	21.2 [29]	20.4 [30]	16.1 [19]	29.0 [36]	25.3 [24]	26.8 [30]
p value (X^2, 3df)		0.75		0.08		0.04	

5.3.5 Carers' attitudes towards their own oral health

Carers' responses to attitude statements on their own oral health were indicated on a five point Likert scale, 'no opinion' responses being excluded from the analysis for the reasons stated in Section 5.3.4. For 11 of 12 statements, the proportion of each type of response remained similar throughout the trial. These data are shown in Table 5.23. For these statements, baseline data alone are reported, since they are typical of data from subsequent time points. The proportion of positive attitudes (i.e. 'strongly agree' or 'tend to agree' with positively worded statements, 'strongly disagree' or 'tend to disagree' with negatively worded statements) were similar in both groups, albeit with wide variation between individual statements.

Table 5.23:
Responses to attitude statements on carers' own oral health for which proportions of positive responses remained similar at all time points (data from all carers responding at baseline)

Key to statements: + *denotes positively worded statement;* - *denotes negatively worded statement*

Statement *(Numbers refer to numbering in questionnaire)*		Response	Baseline	
			C % [n]	I % [n]
14	I believe my own teeth should last me throughout my life. [+]	Strongly agree	47.8 [66]	52.7 [78]
		Tend to agree	44.9 [62]	38.5 [57]
		Tend to disagree	6.5 [9]	6.8 [10]
		Strongly disagree	0.7 [1]	2.0 [3]
15	I find there is very little I can do to prevent myself getting dental problems. [-]	Strongly agree	2.1 [3]	2.0 [3]
		Tend to agree	11.3 [16]	12.8 [19]
		Tend to disagree	31.7 [45]	28.4 [42]
		Strongly disagree	54.9 [78]	56.8 [84]
17	If my gums bleed when I brush, I suppose it means I have been brushing too hard. [-]	Strongly agree	7.2 [10]	5.4 [8]
		Tend to agree	17.4 [24]	21.1 [31]
		Tend to disagree	50.0 [69]	47.6 [70]
		Strongly disagree	25.4 [35]	25.9 [38]
18	Up to now, I feel I have looked after my teeth well. [+]	Strongly agree	31.0 [44]	35.1 [52]
		Tend to agree	54.2 [77]	49.3 [73]
		Tend to disagree	11.3 [16]	14.4 [21]
		Strongly disagree	3.5 [5]	1.4 [2]
19	As you get older, I think you are bound to lose some of your teeth. [-]	Strongly agree	11.6 [16]	9.0 [13]
		Tend to agree	55.1 [76]	56.6 [82]
		Tend to disagree	21.7 [30]	23.4 [34]
		Strongly disagree	11.6 [16]	11.0 [16]

Table 5.23 (continued):
Responses to attitude statements on carers' own oral health for which proportions of positive responses remained similar at all time points (data from all carers responding at baseline)

Key to statements: + *denotes positively worded statement;* - *denotes negatively worded statement*

Statement *(Numbers refer to numbering in questionnaire)*		Response	Baseline	
			C % [n]	I % [n]
20	If I was too ill or disabled to look after my own teeth, I hope somebody would do it for me. [+]	Strongly agree Tend to agree Tend to disagree Strongly disagree	67.4 [95] 30.5 [43] 2.1 [3] 0	72.6 [106] 25.3 [37] 1.4 [2] 0.7 [1]
21	I worry that I haven't been able to look after my teeth as well as I would have liked. [-]	Strongly agree Tend to agree Tend to disagree Strongly disagree	12.2 [17] 38.1 [53] 30.2 [42] 19.4 [27]	15.5 [22] 35.9 [51 27.5 [39 21.1 [30]
22	It is important to me to keep all of my own teeth. [+]	Strongly agree Tend to agree Tend to disagree Strongly disagree	59.8 [79] 34.8 [46] 5.3 [7] 0	66.4 [99] 30.2 [45] 2.0 [3] 1.3 [2]
23	I rely on the dentist to prevent me from getting dental problems. [-]	Strongly agree Tend to agree Tend to disagree Strongly disagree	14.0 [19] 25.7 [35] 44.9 [61] 15.4 [21]	15.5 [22] 24.6 [35] 39.4 [56] 20.4 [29
24	If my gums bleed when I brush my teeth, I worry that I am not looking after them well enough. [+]	Strongly agree Tend to agree Tend to disagree Strongly disagree	14.5 [20] 44.2 [61] 35.5 [49] 5.8 [8]	15.1 [22] 53.4 [78] 21.9 [32] 9.6 [14]
25	It is my own responsibility to look after the health of my mouth. [+]	Strongly agree Tend to agree Tend to disagree Strongly disagree	67.8 [97] 29.4 [42] 1.4 [2] 1.4 [2]	70.5 [105] 26.2 [39] 3.4 [5] 0

For one statement on carers' oral health, shown in Table 5.24, the difference between the groups' responses became more marked as the trial progressed. The distributions were compared using the Chi squared test. While the control showed a fall in the proportions of positive responses at visit 2, followed by a partial recovery at visit 3, the intervention group showed a steady increase in positive responses, their visit 3 level being 21.2% higher than at baseline. Group differences were highly statistically significant at visit 2 ($p = 0.004$) and visit 3 ($p = 0.007$).

Table 5.24:
Responses to attitude statements on carers' own oral health for which the proportion of positive response rates changed during the trial (data from all carers responding at each individual time point)
(Statement number refer to numbering in questionnaire)

16. I feel that dentures are less trouble than looking after your own teeth. [-]

Statement		Baseline		Visit 2		Visit 3	
No	Response	C % [n]	I % [n]	C % [n]	I % [n]	C % [n]	I % [n]
16	Strongly agree	5.1 [7]	6.3 [9]	2.5 [3]	4.1 [5]	10.2 [10]	2.7 [3]
	Tend to agree	13.0 [18]	22.2 [32]	24.8 [30]	10.6 [13]	12.2 [12]	4.5 [5]
	Tend to disagree	39.9 [55]	26.4 [38]	42.1 [51]	36.6 [45]	46.9 [46]	45.9 [51]
	Strongly disagree	42.0 [58]	45.1 [65]	30.6 [37]	48.8 [60]	30.6 [30]	46.8 [52]
p value (X^2, 3df)		0.06		0.004		0.007	

5.3.6 Comparison of derived attitude scores

The Likert scale was graded so that, for positive statements, 'strongly agree' scored +2, 'tend to agree' scored +1, 'no opinion' scored zero, 'tend to disagree' scored -1 and 'strongly disagree' scored -2. Negative statements were reverse-coded, so that 'strongly disagree' scored +2 and 'strongly agree' scored -2. Thus, when scores were aggregated, those with an equal balance of positive and negative attitudes would score around zero, those tending towards more positive attitudes would result in a positive score, and those tending towards more negative attitudes would result in a negative score. Mean attitude scores were derived for control and intervention groups. The distributions at each of the sampling times were normal, therefore means were compared using the independent samples t-test. The intervention group mean score was subtracted from that of the control group. Therefore, where the intervention group had a more positive score, the difference appears as a negative value.

For carers working at baseline and during the period of the intervention, the results of the analysis of mean attitude scores are shown in Table 5.25. (Visit 2 and visit 3 differences could not be adjusted for baseline differences, because it was not possible

to link individuals' data accurately, due to variable patterns of response.) At baseline, the intervention group was marginally more positive than the control group. The difference became much more marked as the trial progressed. Differences were statistically highly significant at visit 2 and at visit 3 for scores on clients' oral health statements ($p = 0.003$ and <0.001 respectively), carers' oral health statements ($p = 0.01$ and 0.005 respectively) and total attitude score ($p = 0.002$ and <0.001 respectively).

Table 5.25: Comparison of attitude scores (data from carers employed at baseline and during the intervention period)

* High score indicates positive attitude.
† Negative value indicates more positive score in intervention group

Responses to attitude statements	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
Number of respondents	106	101	113	116	88	95
Clients' oral health [13 statements]						
Mean score* [max. 26, min. -26]	10.11	11.16	9.66	12.44	8.80	13.73
SD	6.52	6.27	6.97	6.95	7.13	6.55
Mean difference [C-I]†	-1.05		-2.78		-4.93	
CI for difference	-2.80 to 0.71		-4.59 to -0.63		-6.93 to -2.93	
2-tailed p-value	0.2		0.003		<0.001	
Carers' oral health [12 statements]						
Mean score* [max. 24, min. -24]	6.72	6.73	6.02	7.72	6.51	8.54
SD	5.34	4.92	5.26	4.65	5.02	4.52
Mean difference [C-I]†	-0.157		-1.71		-2.03	
CI for difference	-1.42 to 1.39		-3.00 to -0.41		-3.42 to -0.63	
2-tailed p-value	1.0		0.01		0.005	
Total attitude score [25 statements]						
Mean score* [max. 50, min. -50]	16.80	17.35	15.28	19.71	14.60	22.16
SD	10.01	10.15	11.18	10.48	10.94	9.84
Mean difference [C-I]†	-0.55		-4.42		-7.56	
CI for difference	-3.31 to 2.22		-7.25 to -1.60		-10.59 to -4.52	
2-tailed p-value	0.7		0.002		<0.001	

For all carers returning questionnaires at each individual time point, the results of analysis of the attitude score means are shown in Table 5.26. (Visit 2 and visit 3 differences were not adjusted for baseline differences, because the groups were composed of different combinations of subjects at different visits.) At baseline, the intervention group was marginally more positive than the control group. However, the difference became much more marked as the trial progressed. Differences were statistically highly significant at visit 2 and at visit 3 for scores on clients' oral health statements ($p = 0.002$ and <0.001 respectively), carers' oral health statements ($p \leq 0.02$) and for total attitude score ($p \leq 0.001$).

Table 5.26: Comparison of attitude scores
(data from all carers employed at each individual time point in the trial)
* High score indicates positive attitude.
† Negative value indicates more positive score in intervention group

Responses to attitude statements	Baseline visit		Visit 2		Visit 3	
	C	I	C	I	C	I
Number of respondents	146	151	129	132	106	117
Clients' oral health [13 statements]						
Mean score* [max. 26, min. -26]	10.43	11.05	9.53	12.35	9.30	13.27
SD	6.66	6.38	7.11	7.11	7.23	6.74
Mean difference [C-I]†	-0.63		-2.82		-3.96	
CI for difference	-2.12 to 0.86		-4.55 to -1.09		-5.81 to -2.12	
2-tailed p-value	0.4		0.002		<0.001	
Carers' own oral health [12 statements]						
Mean score* [max. 24, min. -24]	7.03	7.04	6.15	7.57	6.79	8.31
SD	5.46	5.10	5.27	4.66	5.01	4.52
Mean difference [C-I]†	-0.01		-1.42		-1.52	
CI for difference	-1.21 to 1.20		-2.63 to -0.21		-2.77 to -0.26	
2-tailed p-value	1.0		0.02		<0.02	
Total attitude score [25 questions]						
Mean score* [max. 50, min. -50]	17.30	17.52	15.15	19.60	15.40	21.44
SD	10.40	10.34	11.46	10.46	11.22	10.11
Mean difference [C-I]†	-0.22		-4.46		-6.04	
CI for difference	-2.59 to 2.15		-7.13 to -1.78		-8.86 to -3.22	
2-tailed p-value	0.9		0.001		<0.001	

5.4 Data from open-ended questions

In the questionnaire, carers were invited to comment on their feelings about oral health care both for their clients and themselves, and to make suggestions for improvements in nursing home oral health care. Responses were coded and indexed into topics. Representative examples are given below, with an indication of the numbers of similar responses received. The bracketed numbers after quotations identify the home (first two digits), the carers (third and fourth digits) and the visit (last digit). The identification numbers of intervention group homes are 01, 03, 05, 06, 09, 11, 13, 16, 19, 20 and 22

5.4.1 Client care

5.4.1.1 Whose responsibility?

The majority of comments supported the ideal of good oral health for clients. Some (33) made general comments:

> 'I believe that all clients teeth should be treated properly. Age should not stop them being treated and looked after the same as you or I.' [05/02/1]

Others (35) showed acceptance of the carer's role, some very positively:

> 'I feel that mouth care...[is] as important as any other personal hygiene we give people - so therefore teeth should be a priority at all times.' [13/09/3]

> 'Most of our clients need all of our help. It is our job to provide a high standard of care which includes "mouth care". I could understand our clients wanting their teeth brushed and cleaned every day and night, as so do I. I know how it would feel if I never looked after my own teeth and gums.' [20/20/1]

> 'I feel too often the mouth care of the elderly is neglected. I personally feel it is a very important part of the daily routine....I feel strongly about the mouth care and the state of some patients.' [13/09/1]

Some felt the carers shared responsibility with the dentist (9) or client (4):

> 'I feel it is part of my job to help look after clients' teeth if they cannot do this themselves, to encourage those who can...' [20/16/1]

> Daily, my brushing will help, but in the long run, I much prefer the dentist to do the regular checks.' [06/13/1]

Several comments (21) identified the client as the responsible person to perform oral health care or initiate the carer's involvement:

> 'People with their own teeth should try and brush them. People with dentures should have a pot and some cleansing solution to try and clean them themselves.' [01/08/1]

> 'Although we as carers are responsible for our clients teeth, it is their choice (if senility permits) to ask for assistance with dental care.' [17/18/1]

Only four carers, all from control group homes, did not accept responsibility for helping clients with oral health care. These responses included:

> 'Personally I do not feel that dental care is part of my job or my responsibility, especially as I have never had any training...' [14/29/3]

> 'I have taken it for granted that clients with their own teeth are capable of looking after their own.' [18/20/1]

5.4.1.2 Quality of oral health care

Six carers commented that no fault could be found with oral care in their nursing homes. However many responses echoed, often in more specific terms, the opinion of one carer who felt there was 'Always room for improvement.' [17/11/1]. Many carers (47) wanted to see staff providing more effective oral care than was currently the case.

> '...very few [clients] are dealt with to a sufficient standard to prevent mouth troubles.' [05/05/1]

> 'I feel that if I was a client, I would like to have my dentures cleaned more thoroughly and more often. As a night worker I have found dentures soaking in the denture pots with food debris floating in the water so it is obvious that they have not been cleaned.' [09/06/3]

> 'I would like to see my teeth scrubbed with a toothbrush, not just put in a denture pot and soaked with a Steradent overnight if I were lucky. If I had my own teeth, I would hope someone would like to brush my teeth, morning and night or if I request at other times.' [20/20/1]

Other carers (65) felt that regular dental check-ups should take place.

> 'I think that the clients should still have dentist check ups every 6 months not only when they are in pain.' [02/08/2]

> '...Why should prevention is better than cure only apply to the young?' [13/07/2]

> 'Just because they are old people, they think [a dental check-up] doesn't matter as they may die soon, but this is wrong!' [18/11/1]

> '...To date I can count on one hand the number of times a dentist has come to the home.' [09/09/1]

5.4.1.3 Barriers to performing oral health care

A substantial number of carers (41) felt that nursing home policy should place a higher priority on oral care:

> 'I feel [oral] care is not being addressed as it should be.' [02/17/1]

> 'I think [oral care] should be taken more seriously as sometimes it is neglected.' [05/03/1]

> 'Teeth tend to get forgotten. We should pay more attention to this aspect of care.' [19/09/3]

> 'Strict regimes that are followed up, especially clients' own teeth. The home should provide Steradent and toothbrushes for all residents - most have none.' [13/15/3]

This last point concerning the lack of oral health care resources evoked the largest number of responses on any topic (71):

> 'A constant supply of cleaning materials. Very often all we have is water.' [19/13/1]

> 'I would like to see dental cleaning products provided by the home...Only clients that provide themselves...get their teeth cleaned properly, e.g. toothpaste and Steradent.' [19/03/3]

> 'Not relying on relatives to provide toothpaste, etc. It should be supplied by the homes.... Toothbrushes should be renewed every 12 weeks.' [02/17/1]

A few carers (3) mentioned lack of time, a few (3) identified distaste for teeth and dentures as barriers to facilitating oral health care:

> 'Although I don't like dentures or real teeth, for 10 years I've had to do them and it is obviously important. I find many nursing staff do not like dealing with teeth or dentures.' [13/15/1]

5.4.1.4 Expressed need for oral health care training

Some carers (6) had no experience of brushing clients' teeth. Others (4) commented on lack of guidance:

> 'We are not taught the correct way to brush a client's teeth. We just have to do what we think is right.' [02/06/2]

> 'I don't always know who has dentures and who has their own teeth, that is one thing we don't always get told' [04/16/1]

Many carers (49) expressed a desire for better information and training.

> 'I feel that more training is needed for members of staff on the importance of dental hygiene...I think that it is taken for granted that everyone knows what to do which is not always the case.' [09/06/2]

> '...carers need to be instructed as to how to care for their clients teeth/dentures. It is one thing doing your own, but something totally different doing someone else's.' [13/06/2]

> 'Nursing homes in general need more training sessions with staff to keep the dental hygiene up to standard. For example I myself have never been trained to clean people's teeth, although I do it.' [14/12/1]

> 'This survey has given me an insight into how much there is to learn about dental hygiene.' [09/13/1]

Another carer with dental nursing experience felt that her dental knowledge was useful in her present job.

5.4.2 Carers' own oral health care

5.4.2.1 Experiences of dental care

Sixty-three carers commented on their dental experiences. Wholly positive comments (13) included:

> 'I have always found that I have received good dental care and...my dentist has not pushed me to have unnecessary treatment.' [22/02/3]

Some carers (3) emphasised how their relationship with their dentist was perceived as an oral health partnership, others endorsed the importance of regular check-ups (2) and of retaining a healthy dentition (2), while one carer expressed her feeling of increased personal responsibility as her awareness of oral hygiene improved (1).

Wholly negative experiences (19) included:

> 'I have been left with a permanent scar on my lower lip as a result of a dentist removing a lower back tooth. He managed to break the tooth in half, then had to cut the gum in 2 places to remove the rest...In hindsight I wish I had taken photos of my injuries.' [03/13/1]

> 'Awful - dentists don't listen to mothers, they plough ahead with bad treatment and lecture patients on diet and lifestyle which is simply none of their business. They are PAID to do a job. I have an education - I do know better, my salary doesn't (sic). Child seen by consultant recently - what a wonderful job - why can't dentists do better?' [07/20/1]

Some (15) had mixed experiences, current treatment being better than in times past:

> 'When I was at school my dentist was very nasty and frightened me so much that I didn't go again until I came to Weston 4 years ago. My dentist now is lovely, he puts me at ease and is very gentle.' [08/08/1]

5.4.2.2 Comments on dental service provision

Thirty-three carers commented on dental service provision. The overwhelming majority (29) complained of the increased cost of dental treatment as many dentists no longer offer NHS treatment. They saw it as a barrier to seeking routine care, particularly for people on low incomes. Several predicted that adults' dental health would suffer as a result:

> 'It is a pity the NHS dentists are pulling out of this field and turning private. The long term effects of this must lead us to an older generation with major dental problems.' [08/05/1]

> 'Dentist visits are getting more and more expensive. I visited my dentist for a 6 monthly check and it cost me £10.34. This might not seem much, but to someone who has children to feed and clothe, it is a lot.' [22/04/3]

5.5 Assessment of oral health education sessions

5.5.1 Carers' assessment

Although the total number of carers employed in the intervention group homes was not recorded at the time of the oral health education sessions, it was likely to be very similar to the 166 employed 4 weeks later, when the second questionnaire was distributed. The number of carers attending the health education sessions was 109 (approximately 66% of the total). The main reasons for non-attendance were working night shifts while not being paid to come to the health education sessions (although some night shift workers did attend) and absence on the relevant days due to sickness or holiday. Carers were asked to fill in an assessment form (Appendix 5) for the oral health education sessions and 81 (74.3%) returned their forms. The results of their assessments are shown in Table 5.27. The scale was worded appropriately for each question. For example, responses to question 1 ranged from 'very well' to 'not at all', while for question 8, the range was 'learned a lot' to 'learned nothing'. The majority of responses were very favourable.

Table 5.27: Carers' assessment of oral health education sessions

Question	Participants' responses Number of responses in brackets			
	Very favourable	Favourable	Unfavour-able	Very un-favourable
1. Was the presenter well organised?	87.7% [71]	9.9% [8]	2.5% [2]	0
2. Did the presenter speak clearly enough?	96.3% [78]	2.5% [2]	1.2% [1]	0
3. Did the presenter make the material interesting?	81.5% [66]	17.3% [14]	1.2% [1]	0
4. Did you understand the presenter's explanations of the material?	88.9% [72]	11.1% [9]	0	0
5. How well did the material fit your needs?	71.6% [58]	24.7% [20]	3.7% [3]	0
6. Was the material presented at a satisfactory pace for you?	20.9% [17]	65.4% [53]	13.6% [11]	0
7. Did you enjoy the session?	67.9% [55]	29.6% [24]	2.5% [2]	0
8. Did you learn anything new?	55.6% [45]	42.0% [34]	2.5% [2]	0
9. Will the information you received help you in caring for your clients?	81.5% [66]	18.5% [15]	0	0

A few participants added comments about the usefulness of the health education:

'More confident about clients' denture care since being told more by the doctor. I feel I am helping to prevent clients' denture problems.'

'I now think about my clients' teeth more. I brush every client's teeth twice a day. I now clean dentures properly before I put them in to soak. I think looking after clients' teeth is very important. I don't think dental issues are covered enough in the home.'

'Found the lecture very useful.'

'Since having the talk about dental care, I feel more confident in the dental care of my clients.'

'It's common sense really. It's just at times we get lazy, but now I realise how important it is.'

5.5.2 Presenter's assessment

The Health Promoter recorded her impressions of the sessions at each home on an assessment form (Appendix 5). She felt that around 85% of the sessions went well and were worthwhile. She covered all the planned material on approximately 70% of sessions, and the majority of the material on the remaining 30% of sessions. In about 50% of the sessions, the majority of carers seemed very interested, contributing to the discussion and the practical elements. In the remaining 50% of sessions, half the carers actively participated while half seemed less engaged by the proceedings. Qualified nursing staff joined the care assistants at 2 homes. Their presence seemed to have a beneficial effect, encouraging the carers to take a more active role. On 2 occasions, a participant with a negative attitude towards the health education had a deleterious effect on the atmosphere of the session. However, on both occasions, the disruptive carer left early, whereupon the remaining staff expressed relief and renewed interest. During another 2 sessions, there were several interruptions as carers left to answer calls from clients.

The average time spent travelling and setting up teaching materials was 33 minutes. The average session lasted one hour.

5.5.3 Costs of the intervention

An economic analysis of the intervention was carried out to assess the costs to the NHS of delivering the programme to intervention group homes and to make a projection of the likely costs of implementing the programme throughout the Avon Health Authority area. Details of the analysis appear in Table 5.28.

Table 5.28: Estimation of costs of health education programme to NHS

Prices calculated for financial year 1996/7 (when trial took place)

Resource	Cost
Fixed costs for study: preparation of teaching aids	
Manikin head (for toothbrushing demonstration and practice)	£100
Partial denture demonstration models	£25
Toothbrushing demonstration models	£25
Laminated photographs	£15
Preparation time†	4 hours = £36.92
Total	**£201.92**
Variable costs of study: delivery of health education programme	
Travelling time†	14.5 hours = £133.84
Presentation time†	19 hours = £ 175.37
Mileage @ 33p per mile	657 miles = £216.81
500 toothbrushes @ 12p each	£60
Printed workbooks	£30
Total	**£616.02**
Average variable cost per client *(201 in intervention group)*	£3.25
Average variable cost per home *(11 intervention group homes)*	£59.36
Projected annual cost of sustaining effect throughout Avon Health Authority area‡	
Equivalent annual fixed costs*	£27.43
Delivering programme to 96 homes (96 x £59.36)	£5698.56
Total	**£5725.99**

† Health educator's time costed at £9.23 per hour (based on £14796 gross salary plus 20% on-costs and 37 hour week)

‡ Based on annual reinforcement of health education

* Based on 10 year useful life of teaching aids and a discount rate of 6%

Chapter 6

DISCUSSION

Introduction

The first part of this chapter will cover methodological issues. These include the reasons for selecting the two different study populations; the ethical justifications for research among elderly people, the implications of a randomised controlled trial design, and the choice of outcome measures and scoring methods. The background to developing the oral health education programme will be described, together with the reasons for evaluating its effectiveness.

Next, results obtained from clinical examination of clients at different points in the trial will be compared and discussed in relation to findings from other studies. The improvements in oral health status in the intervention group will be interpreted in the light of reports of staff assistance with oral health care during the trial. The effect of adjustment for clustering on analyses of the data will be discussed, together with the issue of multiple comparisons.

The final part deals with data from the carers' survey. Predictors of oral health knowledge and attitudes will be discussed. Differences in knowledge and attitude scores between the allocation groups will be interpreted and compared to results from similar studies. The presenter's and participants' assessments of the intervention will be considered, and a projection made of the likely costs of extending the health education programme throughout the Health Authority area.

6.1 Discussion of the study method

6.1.1 Measurement of clients and carers

Two separate groups of individuals were studied, nursing home care assistants and their clients. Health education was directed at carers rather than clients because Schou *et al.* (1989) found that targeting nursing home clients directly had virtually no effect on their oral hygiene, either due to their apathy or their poor health. Another reason

for selecting care assistants was that they, rather than qualified nurses, perform the majority of personal care for clients (Burgio & Burgio, 1990; Power, 1990; Adams, 1996). Indeed, Power (1990) considered aides to be the dentist's foe or greatest ally in promoting good oral health care. In order to assess if changes in carers' knowledge or attitudes to oral health care were translated into changes in the practice of that care, it was also vital to examine the oral condition of the clients in their care.

6.1.2 Ethical considerations when carrying out research among institutionalised elderly people

The fact that an individual is elderly and institutionalised need not necessarily pose any special ethical issues for a researcher. Studies aimed at benefiting elderly people often cannot be carried out on other sections of the population. In such cases, provided the procedures are not contrary to their interests, expose them to only minimal risk and may potentially benefit others in the same category, the use of elderly volunteers may be justified, subject to the provision of valid consent and local Research Ethics Committee approval (British Medical Association, 1993).

Subjects in this study were not induced financially, nor coerced into participation. Those wishing to participate gave informed consent and were free to withdraw at any stage. In fact, only 3 clients withdrew because they did not wish to be re-examined, while the majority seemed to enjoy the special attention they received. Many said the examinations relieved the boredom they often felt and expressed regret when the study ended.

None of the parties concerned opposed the study. Ethics Committee approval was given unconditionally by four different healthcare trusts. No refusals from owners or matrons were encountered when recruiting homes. Most carers responded very favourably to oral health care education. The study was well received by clients. Altogether, the response should be encouraging for others contemplating research in this field.

6.1.3 Choice of research method

In medicine and allied fields, a randomised controlled trial is considered the best method of testing the effect of a treatment intervention. Random selection of subjects and random allocation to control or intervention group largely avoids bias in the composition of the two groups. Since the groups are assumed to be equivalent in all respects apart from exposure to the intervention, confounding factors (such as age, sex, social class) are accounted for and, in theory, any difference between the groups after the intervention can be attributed solely to the effects of that intervention (Fraser *et al.,* 1995).

Like most studies in health services research, this study was pragmatic rather than explanatory in concept (Schwarz & Lellouch, 1967), being concerned with deciding which treatment was preferred. An entirely pragmatic study is difficult to perform since, for ethical reasons, sufficient information has to be given for the purposes of informed consent. However, the intervention was implemented without suggesting to the homes any direct association between the client and carer surveys. The purpose of the client survey was explained as identifying any changes in frail, elderly persons' oral health over a period of time. The carers' survey was explained as a method of assessing the educational effectiveness of the oral health care training programme. Control group allocation was discussed only in relation to the carer survey. The degree of control over delivery of oral health care was relatively low. The health education intervention was delivered to a sample of subjects, who then, in the light of their knowledge and attitudes, made their own decisions about how they implemented oral health care for clients. Even arranging for health education to take place at the most convenient times for each home, it was not possible to achieve the attendance of every carer. The research design allowed for withdrawals from whatever cause, such as is bound to happen under practical conditions. A predetermined margin was also set by which the intervention should surpass the control in order to be considered clinically superior. Thus the treatment received by the two groups would be compared under the 'normal' conditions that would apply in practice.

The use of quantitative methods enabled variables, such as attitudes or health status, to be defined in a way that permitted measurement. By classifying and comparing characteristics, differences or similarities between the responses of individuals or groups of people may be identified. A more qualitative element was also included in the form of open-ended questions in the carers' questionnaire, permitting respondents to express, from their own perspective, opinions associated with the topics under consideration. Subtle insights may often be revealed by qualitative data collection where quantitative methods are too inflexible to record unexpected findings or to identify the needs and values of the target group (Blinkhorn *et al.*, 1989).

6.1.4 Issues arising from the research design

6.1.4.1 Blindness

Ideally, a randomised trial would be double-blind. However, in certain types of trial, such as those using health education and surgery interventions, double blindness is not possible. Blinding of the researcher worked effectively, due to the safeguards incorporated in the study design (Chapter 3, Section 3.3.3). There was only one potential breach when the researcher, arriving for an examination visit, was asked by a deputy matron whether she had come to give a dental health talk to the staff. The researcher reminded the matron about concealment and proceeded with arrangements for clients' examinations. On reflection, the question could have been taken either way. Either the matron knew that a talk would be given at some stage in the trial and wondered if that moment had arrived; or a talk had already been given and she was expecting another.

The researcher's guesses regarding the allocation group of each home proved to be no more accurate than would be expected by chance. This showed that the clinical assessments were not biased by any knowledge of allocation. As a precaution against bias, once data had been collected at any visit, they were not re-examined until after the trial had ended.

6.1.4.2 Recruitment of nursing homes

Reactions to the proposed study varied from neutral to very enthusiastic. The staff training element of the study appealed to all matrons. Todd (1990) found that many nursing homes felt that responsibility for staff training should lie with colleges or the NHS. There certainly seemed to be a sense almost of relief that help was being offered. Some matrons commented that they lacked either the time or the knowledge to train staff in oral health care. Somewhat to the researcher's surprise, not one matron refused to allow his/her home to participate in the study, although for the reasons stated in Chapter 4 Section 4.1.3, not all homes that were approached fulfilled the inclusion criteria.

6.1.4.3 Sample size

Initial advice on sample size did not include a specific adjustment to allow for cluster randomisation, although a compensatory, arbitrary increase was included. Although formal retrospective power assessment would be invalid, analysis of the results nevertheless indicates clearly that the study was sufficiently large to show up with acceptable precision the impact of the intervention on the majority of outcomes. This was particularly noticeable with respect to plaque measures, even though oral health levels remained short of ideal, even in the intervention group.

6.1.4.4 Outcome measures as proxy for longer-term benefits

Although client outcomes were measured over the limited period of the study, there is evidence that they are likely to be proxy for longer term benefits. Repeated cross-sectional studies of different cohorts of elderly people indicate that oral health is improving among all older age groups. The long-term effects of better oral health in the elderly have been shown by indicators including edentulousness, the total number of remaining teeth and numbers of sound intact, filled or decayed teeth (Todd & Lader, 1991; Ainamo & Österberg, 1992; Jokstad *et al.*, 1996). The outcome measures selected for this study covered both dentate and edentate subjects, so that appropriate comparisons of oral health status may be made by future researchers.

6.1.4.5 Environmental limitations

The choice of clinical scoring measures took into account the environmental limitations of the examination place and the physical limitations of the subjects. Facilities such as surgery lighting and compressed air for drying teeth were unavailable. Many subjects were disabled or unable to sustain an upright posture. Frail subjects were liable to fatigue if the examination were too lengthy. Care was therefore taken to follow the recommendations for survey work of Barnes *et al.* (1986) and to choose methods which gave sufficient information to evaluate preventive care levels while being simple to use, acceptable to subjects and requiring minimum time and minimum armamentarium.

6.1.5 Clinical scoring methods

6.1.5.1 Reliability of scoring methods

The choice of a single examiner, trained to the standards of an experienced clinical trials unit, rather than multiple examiners (discussed in Chapter 3 Section 3.1.4) eliminated an important source of examiner variation. The dental plaque index of Greene & Vermillion (1964) was chosen because a study using 81 examiners of differing professional status showed less than 10% variation in repeat scoring by the same examiner (Llewelyn & Addy, 1979). Although there is no published work on intra-examiner variation for denture plaque scoring, the similarity between denture plaque area measurements (Augsburger & Elahi, 1982) and tooth plaque area measurements (Greene & Vermillion, 1964) make it reasonable to assume that intra-examiner variation would also be low. Other indices used binary systems, except for gingivitis, which measured inflammation at the extremes.

6.1.5.2 Oral health measures for denture-wearing subjects

Few scales have been developed for measuring denture plaque. Some were unsatisfactory for this study because they required laboratory facilities such as optical

or scanning electron microscopes (Nicholson *et al.*, 1968; Connor *et al.*, 1977). A 10 point scale (McCabe *et al.,* 1996) had proved unreliable in a clinical setting, and was considered too complex for the present study. Augsburger & Elahi's (1982) 5-point scale for disclosed plaque was therefore selected as best suited to a domiciliary situation.

Recent plaque, which had accumulated on dentures during the day (Addy & Bates, 1979), was not of prime interest. Mature denture plaque would, however, indicate more extended neglect of routine denture care. Only mature denture plaque was therefore assessed, areas being scored if disclosed by the blue dye in the two-tone disclosing solution, as outlined in Chapter 3 Section 3.3.3. This system of scoring also avoided the potential difficulty of scoring red-dyed plaque against pink denture acrylic.

The most commonly used classifications for denture-induced stomatitis (Newton, 1962 and Budtz-Jørgensen, 1978) both define the same 3 categories of inflammation, based on the appearance of the inflamed mucosa of the denture-bearing area. These authors employed slightly different terminologies, Budtz-Jørgensen's (1978) being used for this study.

6.1.5.3 Oral health measures for dentate subjects

Because of environmental limitations, a relatively simple dental plaque scoring method based on Greene & Vermillion's (1964) simplified oral hygiene index was chosen. The 4 point scale was more sensitive than the binary index of Lenox & Kopczyk (1973), but more suited to epidemiological work than the sensitive 6-point scale of Quigley & Hein (1962). Greene & Vermillion's (1964) method was modified (i) to include the use of disclosing solution to permit a readily visible, less time-consuming method of assessment than drawing a probe across the tooth and (ii) to record the proportional coverage of plaque on two, instead of one, surface per tooth. The latter modification provided a measure of severity without being as arduous for the subjects as indices scoring 4 surfaces (e.g. Ramfjord, 1956).

For gingivitis, a hybrid scale was developed for simplicity of use in the nursing home. O'Leary's (1967) method was adapted to score buccal and lingual surfaces separately, in order to assess which surfaces received oral hygiene attention. O'Leary's (1967) method allocates to each segment the highest score for any single tooth in that segment, thus highlighting the severity of the disease and the relative urgency of treatment need. However, the index may overestimate the average severity of the disease. O'Leary's scale of 4 points with very detailed criteria was discarded in favour of the simpler 3 point scale of Suomi & Barbano (1968).

The secondary outcomes of calculus, cervical/root caries and tooth mobility were scored on a binary scale, which reduces the likelihood of false positive scores, although it may result in some false negatives.

6.1.6 Questionnaire design

The use of tick boxes for the majority of questions made the questionnaire simple to complete within a relatively short time and made it more likely that recipients would complete all the questions. The Likert scale for attitude statements was chosen because it tends to perform well in roughly ordering people in respect of a particular attitude. Although less laborious and problematical to construct than Thurstone or Guttman scales, it correlates well with Thurstone and is thus widely used (Oppenheim, 1992). The inclusion of open-ended questions was considered an important way of empowering a group of generally disempowered workers to put forward their views (Oppenheim, 1992), and provided useful insights into the way oral health care was carried out in the homes. Personal questions were placed at the end, where they were less likely to cause resentment or suspicion, or if they did, at least replies to the main questions would not have been affected (Dawson, 1995).

The questionnaire was self-administered, a method that usually has a high response rate. However, the pilot study indicated that collection of completed questionnaires within the home produced a far higher response rate than asking carers to mail them in

stamped envelopes addressed to the researcher. This seemed to confirm the experience of Herriman & Kerschbaum (1990), who only achieved a 51% response rate to their postal survey of nursing home carers. It was therefore decided to delegate collection of questionnaires to the nursing home management, indicating a closing date a month after distribution, and providing a large, pre-paid envelope for their return. Reminder questionnaires were sent and collected from non-responders in the same manner. This system worked well, since a response rate of around 80% was achieved.

6.1.6.1 Reliability and validity of the questionnaire

The reliability of a measure refers to the consistency of the measure and the probability of obtaining the same results if the measure were repeated. Validity concerns the ability of a measure to record what it is supposed to measure.

For factual questions, several internal reliability checks are recognised; in this study, the checks employed were repeating questions in a different way, and repeating the questionnaire at intervals during the trial. Validity of factual questions may be ascertained by the use of external checks from a second, independent source of information, if available; in this study, a partial check was possible by examining carers' behaviour through oral health measures in clients. This was, however, an imperfect method, since knowledge and behaviour are at different points on a learning continuum (Blinkhorn, 1981). Moreover, since all replies are entirely dependent on the respondent's ability and willingness to retrieve the required information, major problems of validity of factual questions are considered inevitable (Oppenheim, 1992).

Attitude questions are more complex than factual questions because they are sensitive to changes in wording or emphasis. A single question is unlikely to reflect an attitude adequately; however, it is almost impossible to ask the same question in a different form, since, with different wording, it will no longer be the same question. In this study, the problem of reliability was addressed by using a set of questions on the same theme, with a roughly equal balance of positive and negative statements. Balanced sets of questions are more reliable than single attitudinal items because any bias

caused by vagaries of wording will tend to be cancelled out, while the underlying attitude will be common to all items in the set. (Oppenheim, 1992).

There is a problem with validity of attitude questions, due to the lack of external criteria. Behaviour cannot necessarily be predicted from attitudes, and attitudes cannot be inferred from behaviour. There is a lack of any strong theory regarding attitudinal constructs in people's minds, which leads Oppenheim (1992) to state that 'attitudinal validity remains one of the most difficult in social research, and one to which an adequate solution is still not in sight.' When producing attitude statements, useful indicators of the wrong path being followed include the wish of pilot study respondents to quibble or change wording, and a high proportion of uncertain or no opinion responses. Neither of these factors was apparent during piloting of the present study.

6.1.6.2 Identification of respondents

By using questionnaires with personal identification numbers, it was hoped to link responses to individual carers at each point in the trial. In most cases, this system appeared to work satisfactorily. However, in a small number of cases, questionnaires bearing the same number had evidently been completed by a different carer on different occasions. Distribution of questionnaires was delegated to matrons, since not all carers were working on the shift when the researcher was present. Thus, carers may have been given the wrong questionnaire, or have picked up and completed another carer's questionnaire. In cases of uncertainty, where the respondent could not be identified by comparing handwriting and data from previous occasions, questionnaires from different points in the trial bearing the same identification number but different personal data or handwriting were analysed as coming from different carers.

6.1.7 Oral health education session

Previous studies of carers' attitudes to clients' oral health care (Eadie & Schou, 1992; Fiske & Lloyd, 1992) had identified mixed feelings. Most carers supported the idea of

clients enjoying healthy mouths, but many felt they lacked the necessary training in oral health care and some were disinclined to involve themselves. The intervention in this study was therefore planned to be relevant to carers' needs and to involve them in the education process. The emphasis on 'How can we work together to prevent further dental disease or discomfort in these medically stressed patients?' reflected Quinn's (1988) recommendations.

Ewles and Simnett's (1995) planning process was followed and the content of the programme was designed to convey a straightforward message which could successfully be presented within the time available. The aim of achieving lower plaque levels for clients was realistic; plaque control was an area where carers could make a difference to clients' oral health without recourse to professional dental intervention and, as Sheiham (1983) advised, they were being encouraged to reduce plaque rather than being expected to eliminate it entirely. Since care assistants belong to a low-paid, low status, untrained occupational group, it was important to avoid any issue of blame for clients' oral state. The objectives of the programme were therefore directed towards raising awareness, improving knowledge and skills, and increasing self-esteem. To help achieve this latter aim, all participants were presented with an attractively printed certificate of attendance, inscribed with their name, which proved very popular.

Evaluation of the health education intervention was an integral part of the study. Benefits resulting from health education are frequently more difficult to quantify than the benefits of more direct therapies, such as those employing drugs or surgery. Health education, therefore, attracts a good deal of criticism and scrutiny, and is required to justify its effectiveness and use of resources (Blinkhorn, 1993). This study employed an experimental design, which is the strongest that can be used to demonstrate the effectiveness of a health education intervention in achieving specified outcomes. Compared to other designs, clearly specified experimental designs show high reliability, replicability and internal validity. If carried out in a community, as this study was, rather than an artificial setting, they are likely to have high external validity and more generalisable findings (Tones & Tilford, 1994). The attainment of the

study's stated objectives was assessed quantitatively, using the carers' questionnaire to monitor their knowledge and attitude levels, and the clinical examination of clients to monitor carers' behaviour. From these data, it was also possible to assess the fading of the programme over time. The presenter's data on the cost of resources and the time spent on all aspects of the programme were used to estimate the costs of the intervention to the NHS provider. A programme assessment, using a short questionnaire, measured the intervention's relevance and usefulness to carers. A similar questionnaire assessed the problems encountered during presentation by the Health Promoter.

6.1.7.1 Modifications effected after piloting

Originally, it was intended that carers should practise brushing each others' teeth, but during pre-testing of the programme, carers proved very unwilling to do this. Their reticence may have sprung from shyness or from embarrassment, either if they felt their teeth were not as healthy as they would have liked or if they wore dentures whose presence they wished to conceal from colleagues. The manikin head was a good substitute for brushing practice. Nonetheless, the Health Promoter reported that this was the task participants least enthusiastically embraced.

It is interesting to speculate that reluctance to provide intraoral hygiene care, frequently encountered among carers, may arise from the perception of the mouth as a boundary between the internal parts of the body and sources of external pollution. This relationship is discussed by Nettleton (1995), who quotes Boyd (1920) as describing the significance of 'the portals through which infective agents enter the body' and arguing that 'the principal body orifices play an important part, particularly the orifices of entrance, rather than those of exit.' Perhaps this may partly explain why dealing with clients' incontinence is perceived as a natural part of care, whereas oral care is somehow seen as intrusive and inappropriate. If a successful psychological approach could be found to effect a change of perception of the mouth, many oral health care promoters' problems might be solved.

6.1.8 Statistical considerations: the effect of cluster randomisation

For controlled trials, individual randomisation is the conventional approach. However, there are some situations, including assessment of health education, public health and general practice research, where it may be necessary or desirable to take a group or cluster as the basic unit of randomisation. In many cases, cluster randomisation may actually increase external validity, if, for example, the treatment or intervention will eventually be applied at cluster level.

In this study, the experimental unit was the nursing home. The most important practical reason for this design was the need to avoid intervention group contamination, since carers in the same workplace may influence each other. Analysis of clustered data has to be done at the level of the experimental unit. There are two sources of variability: that between individuals in a cluster and that between clusters, the latter being likely to exhibit greater variation. The reasons for greater between-cluster variation include the way that important covariates at cluster level affect all members of the cluster in the same manner and the tendency of individuals within clusters to interact and therefore to respond similarly. This can be especially important when the intervention is provided in a group setting. Although cluster randomised designs are valid, between-cluster variation has to be taken into account in the analysis, otherwise spurious probability values may be obtained. The statistical effect of clustering is usually to reduce the effective sample size, and to increase the size of standard errors and confidence intervals compared to similar studies using simple randomisation. From the analytical point of view, Donner *et al.* (1981) described how the comparison of means or proportions can be derived by adapting the standard analysis of variance among clusters; the standard error imputed by this method to the difference between two means or proportions allows for between-cluster variation being likely to exceed variation within clusters. Because analysis adjusting for clustering tends to increase the standard error and widen confidence intervals, only the most robust effects are likely to reach statistical significance. These effects can be seen in the analyses of data in the present trial.

6.2 Discussion of findings of clients' survey

6.2 1 Issues of sampling

6.2.1.1 Nursing home occupancy rates

The average bed occupancy rate of 82.5% may appear rather low. However, most homes usually have a few empty beds due to normal turnover of clients. Additionally, many homes take people for temporary respite care while family carers are on holiday. Subjects in this category were excluded from the trial and from calculations of bed occupancy. During the period of this trial, resident numbers also dropped slightly due to competition for new clients from a number of large newly-opened nursing homes in the area.

6.2.1.2 Loss of subjects during trial

From a baseline sample of 412 subjects, 316 individuals (76.7%) contributed data at all 3 visits. In addition, one subject was in hospital at visit 2, but contributed data to baseline and visit 3. Loss of subjects can be a particular problem in elderly populations where death, morbidity and relocation may occur. Vigild (1990) recorded a 30% loss from baseline in a study lasting a year. Payne *et al.* (1995) found that a 30-40% loss of baseline sample may potentially affect the representativeness of longitudinal studies. However, in this study, loss of baseline subjects was only 23.3%, with group characteristics remaining relatively constant.

In addition to the core of subjects who completed the trial, new subjects, admitted to homes since the previous visit, were recruited at follow-up visits. This procedure is not typical of a trial. However, the overall level of oral health care in any home would affect all the residents, not just those who entered the study at baseline. Including all eligible residents at each visit therefore had the advantage of permitting a more

representative cross-sectional picture of overall oral health care within the homes. Data from all clients were therefore included in the descriptive analysis. Twenty-eight new subjects were recruited at visit 2 and thirty-three at visit 3. Thus the total number of subjects recruited was 473, of which 101 subjects (21.4%) were lost to the trial due to death (87), relocation (8), withdrawing (3) or illness (3).

However, for the main analysis of the trial, examining the efficacy of the intervention, only subjects contributing data at both baseline and follow-up visits were included. Of 376 subjects contributing data at visits 1 and 2, only fifty-nine (15.7%) had been lost by visit 3.

6.2.2 Comparison of clients' oral health in control and intervention groups

Several studies from around the developed world have reported findings among nursing home populations, including Stockwell (1987), Mersel (1989), Stuck *et al.* (1989), Tobias & Smith (1990), Ainamo & Österberg (1992), Fiske & Lloyd (1992), Merelie & Heyman (1992), Jokstad *et al.* (1996) and Knabe & Kram (1997). All these authors reported a similar picture to that found at baseline in the present study, and their findings will form the principal comparisons to the data reported here.

6.2.2.1 Demographic characteristics

The subjects in the present study conformed closely to the population pattern of nursing home residents seen in the studies listed in Section 6.2.2.

In this study, mean age was around 84, comparable with the 80-85 range in the studies cited above. Younger subjects were as functionally dependent as older residents. The clients under 60 suffered from multiple sclerosis (1), severe strokes (3) and advanced ankylosing spondylitis (1).

The proportion of females was around 80%, comparable to the 68-87% range in the similar cited trials. The ratio of female to male subjects was consistently lower in the control group. There appears to be no explanation other than chance and anecdotal evidence that existing male residents tend to attract new male clients hoping for like-minded companionship.

All subjects were functionally dependent to some degree. Well over half were unable to walk, even with assistance, this finding conforming with those of Coni *et al*, (1993). Generally over the period of the trial, subjects became less mobile. The health of clients surviving the entire trial could be expected to deteriorate. However, staff also remarked that newly admitted clients exhibited increasingly higher dependency levels. This was attributed to the 'care in the community' policy keeping elderly people at home beyond the optimum time for elective nursing home admission.

These findings confirm the high degree of dependency of nursing home clients for help with the basic activities of daily living.

6.2.2.2 Dental attendance and perceived dental treatment need.

Despite the recognised desirability of annual medical screening of individuals aged over 75, the same concern does not exist for regular dental screening in this age group. The proportion of subjects with no recall of dental attendance decreased slightly during the trial, perhaps because repeated questions prompted their memories. Over 70% of subjects had not seen a dentist for 5 years or more, a finding that is similar to those reported in the trials cited in Section 6.2.2. The proportion having seen a dentist during the previous year was consistently higher in the control group, although still less than 20%. That figure is around half the rate recorded nationally for over 75-year-olds in the Adult Dental Health Survey (Todd & Lader, 1991). Of the whole study population only 13% (54 out of 412) had seen a dentist within the last year, compared to 33% active registrations in southern England (excluding London) among elderly aged over 75 (Dental Practice Board, 1997).

These findings cause concern. Not only are institutionalised, chronically sick, elderly people especially at risk of developing root caries (Galan & Lynch, 1994), high levels of dental and denture plaque (Ekelund, 1988) and associated mucosal pathoses (MacEntee & Scully, 1988); they also experience an age-associated increase in oral cancer (Ward-Booth, 1988). This has led to the United Kingdom Working Group on Screening for Oral Cancer and Pre-cancer (1993) recommending 12-monthly screening of all elderly people during routine dental examinations. This target is clearly not being met among nursing home clients, nor, judging from figures for dental attendance in the elderly (Dental Practice Board, 1997), in the general population.

Few subjects recollected being offered a routine dental check-up by staff since admission. Examinations were usually arranged only in response to an expressed problem. The process of conducting the trial was not expected to be a significant factor in influencing the pattern of dental consultation, and this proved to be true. These findings reflect the low priority given to oral health, and contrast sharply with the universal nursing home provision for medical care (Soh, 1992; Vigild, 1992). The reason may be that the medical profession is poorly informed on dental matters, failing to consider oral health in the context of general health (Diu & Gelbier, 1987), despite reported links between poor oral health and systemic disease (Mattila *et al.*, 1989; Beck *et al.*, 1996; Scannapieco & Mylotte, 1996).

Only 20-25% of subjects complained of a current dental problem. Although this finding lies within the range of 12-39% reported in the similar studies cited in Section 6.2.2, it represents a perceived need for treatment that is lower than the researcher's assessment of treatment need. The low perceived need may reflect the low expectations of oral comfort reported among elderly people (MacEntee *et al.*, 1988; Kiyak, 1988; Sheiham, 1990) or the hesitancy of many elderly to report symptoms of any kind (Berkey, 1988). Nevertheless, the numbers of subjects in both groups complaining of problems consistently exceeded those for whom staff had suggested a dental examination. The deficiency may lie with clients failing to report symptoms to carers, or as Merelie & Heyman (1992) found, with carers failing to report problems to nursing staff or with nurses failing to act on carers' reports.

Many clients recognised deficiencies in oral health care standards because 'they only soak [dentures] here' and 'the staff are very lax about [natural] teeth', yet did not perceive these inadequacies as oral health 'problems'. Just as residents are often reluctant to criticise staff (Pearson *et al.*, 1993), they may also be reluctant to request assistance with oral care, if not offered it.

6.2.2.3 Responsibility for care of dentures

At the beginning of the trial, some heavily dependent subjects claimed to clean their dentures when it appeared an unlikely possibility. Their responses were thereafter verified with staff. Pietrokovski *et al.* (1995) and Merelie & Heyman (1992) also found discrepancies between elderly subjects' reported denture care and the clinically detected debris and plaque. Possibly, as Schou & Eadie (1991) reported, elderly people were sensitive about oral hygiene, rejecting any implication that they could not care adequately for their teeth or dentures. In future studies, this factor should be remembered when eliciting denture cleaning information.

Throughout the trial, the majority of denture wearers reported difficulty or inability to clean their dentures. Control group subjects were twice as likely to report they cleaned their own dentures easily, but many 'self-caring' individuals in both groups described only soaking, not brushing, dentures. Even when institutionalised people brush their dentures, it tends to have little effect on denture plaque levels (Schou *et al.*, 1987). This is probably related to failing manual dexterity, which Ostwald *et al.*(1989) reported as the best independent predictor for dependent living. This finding suggests that all nursing home clients should have their ability for denture care sensitively assessed, even when they consider themselves able to cope. Adequate degrees of support and assistance could then be planned and negotiated with the client.

By the end of the trial, both groups' ability for independent denture care decreased, by 4.3% in the control group and 6% in the intervention group. Simultaneously, staff in both groups improved their daily cleaning rate. The increase in reported activity was much more marked among intervention group carers, especially at visit 2, suggesting

that, as a result of the health education intervention, staff were assuming a more active role.

However, the standard of cleaning matters as much as the frequency. This will be considered below (in Section 6.2.2.6) in relation to denture plaque levels.

6.2.2.4 Responsibility for care of natural teeth

The situation at baseline was a serious indictment of the standard of oral health care in nursing homes. Although three-quarters of all dentate subjects reported difficulty or inability to brush, none had their teeth regularly brushed by staff. Knabe & Kram (1997) reported a similar situation in Germany. Slightly more favourable figures were recorded in a study in Finland (Ekelund, 1988), where only 8% of subjects found brushing difficult or impossible, and over half of these received help (although the results were no better than those achieved by clients) and another in Japan (Miyazaki *et al.*, 1992) where 8% of clients had their teeth brushed daily by staff.

Too often, as Blaney (1986), DeWalt (1975) and Felder *et al.* (1994a) reported, and as carers' replies to an open-ended question in this study revealed, clients with natural teeth are assumed to be dentally self-caring. As subjects become institutionalised, the environment predisposes them towards ineffective dependent behaviour. If assistance is not offered, clients may not request it. Subjects frequently explained that oral hygiene assistance was unavailable because 'the nurses are so busy.' Some times during the day are undoubtedly hectic for staff, but there are other times, for example, during the afternoon, when clients require little direct care; however, this part of the day does not appear to be utilised to catch up with neglected aspects of care.

As the trial progressed, there was evidence of the Hawthorne effect as staff in both groups brushed teeth daily or occasionally for more subjects. Improvement in staff activity was most marked in the intervention group, which may be a direct result of the health education intervention. Distribution of toothbrushes for clients by the Health Promoter may also have encouraged intervention group brushing, particularly as carers cited lack of toothbrushes as a major deficiency in homes. The best figures

for assisted brushing, while still short of ideal, came at visit 3 when, of clients totally unable to brush in the control group, 4% (1/24) received daily assistance and 17% (4/24) received occasional assistance; in the intervention group, 14% (2/14) received daily assistance and 57% (8/14) occasional assistance.

There was a progressive decrease in intervention group subjects who were either unable to brush or who reported that they brushed easily. There was a corresponding increase in those reporting brushing with difficulty. This may have been the result of clients having better opportunities for oral hygiene, either due to better availability of toothbrushes or to staff more regularly offering clients the use of a toothbrush. Thus, clients previously unable to brush now found that, when presented with a brush, they could, with difficulty, attempt self-care. Similarly, clients who reported brushing easily may not have been brushing at all, and when they had the opportunity, they found self-care more difficult than they expected. It does appear that, as the trial progressed, more clients were given the option of regular oral hygiene, even if they did not receive direct help with brushing. However, for those still unable to brush, the numbers of assisted clients did not at any time approach the number needing help.

In their questionnaires, carers often cited lack of client co-operation as a reason for not brushing clients' teeth. However, all dentate subjects had their teeth cleaned by the researcher after plaque had been disclosed and scored. None indicated verbally or non-verbally that brushing was unwelcome. Many commented favourably on the pleasant feeling of clean teeth. These disparities in carer and researcher observations may arise because assumed lack of co-operation provides a convenient excuse for a carer avoiding a particular duty, or they may derive from carers' experiences with cognitively impaired clients, who are undoubtedly more difficult to manage. This latter excuse cannot be used for the research sample, which excluded such clients. Alternatively, subjects may have co-operated better with the researcher because they perceived a dentist as a more appropriate person than a carer to operate in their mouths. The increase in the proportion of intervention group subjects receiving help after the health promotion sessions suggests that once carers had more information and greater confidence in their ability to provide oral health care, co-operation became

less of a perceived problem. However, assistance remained at a lower level than that necessary for the majority of dependent clients to enjoy adequate oral health. Clearly, training in this aspect of oral care requires further consideration.

6.2.2.5 Baseline oral health levels

The average oral health status of subjects at baseline was generally poor as reported in Chapter 4 Section 4.3.2, and reflected clear deficiencies in the standard of oral health care provided in the homes. Poor hygiene was reflected in the high surface coverage of plaque on both dentures and natural teeth, and the high levels of associated mucosal and gingival inflammation. The lack of provision for professional dental care was reflected in the low percentage of subjects who were calculus-free (around 18%) and the proportion of sites with active cervical/root caries (4% intervention group, 9% control group).

More upper than lower complete dentures were worn, reflecting the higher level of neuromuscular adaptability required to control lower dentures. Few partial dentures were worn in relation to numbers of partially dentate subjects, perhaps reflecting a lack of interest in appearance, which in turn may be connected to the low morale that can accompany institutionalisation (Vogel & Mercier, 1991). Alternatively, carers who find difficulty inserting a partial denture may cease to offer the client the opportunity to wear it.

The baseline level of edentulousness was 71%, and changed little during the trial. This level was slightly lower than the 80% edentulousness in over 75-year-olds reported in the 1988 Adult Dental Health Survey (Todd & Lader, 1991). In the intervening years, edentulousness levels are likely to have dropped, following the national trend. Recorded levels in this study would have been slightly reduced by excluding edentulous subjects without dentures. However, the figures do reflect the trend for numbers of edentate elderly individuals to fall. The corresponding rise in numbers of people retaining natural teeth implies that treatment of this age group will become more complex and therefore more time-consuming in the coming decades.

The mean number of teeth during this trial was 11.3, which is comparable with other European studies (Vigild, 1988, 1989; Mersel, 1989; Ainamo & Österberg, 1992; Merelie & Heyman, 1992; Jokstad *et al.,* 1996). However, the survival time of these teeth was questionable, since the level of hygiene was low. For example, the youngest subject in the trial, a 42 year-old with advanced multiple sclerosis, newly admitted at baseline to a control group home, suffered rampant caries during the trial, despite being nominally under the care of a local visiting dentist. This subject's teeth had previously been well cared for, yet by the end of the trial, he had widespread cervical and coronal caries.

6.2.2.6 Denture hygiene and mucosal health

The aspects of these inter-related issues that were measured were soft denture debris (to assess whether dentures were rinsed after meals), calculus and plaque deposits (to assess whether appropriate denture cleansing routines were followed) and denture-induced stomatitis (to assess whether unhygienic dentures were likely to have been worn over an extended period of time).

The improvements in denture hygiene in the intervention group were the most successful effects of the intervention. The improvements were even more marked at the 6-month follow-up visit than they were one month after the intervention. These findings suggest that denture cleaning may be significantly improved when staff have been trained in the appropriate methods, but that it took a short while for new practices to come into general use. The fact that denture-cleaning is performed outside the mouth, and is therefore perceived as a non-invasive procedure, may contribute to its widespread adoption among intervention group carers.

Soft debris levels were reduced at follow-up visits in the intervention group. Six months after health education, the intervention group's upper and lower dentures showed reductions in the proportions with soft debris of 17% and 30% respectively suggesting that more dentures were being rinsed after meals. However, with proportions of debris-free dentures not rising during the trial above 35% at best, there was still room for improvement.

Calculus deposits at baseline were found on over 60% of all dentures, a figure that agrees closely with the findings of Hoad-Reddick *et al.* (1990). At visit 2, both groups showed a reduction in calculus levels, although it was more marked in the intervention group. By visit 3, the control group maintained the reduction while the intervention group had further reduced denture calculus levels by around 37% compared to baseline.

There is no obvious reason to explain the reduction in the control group. All inspections were performed by one examiner, eliminating an important source of examiner variation, but it is not possible to identify whether scoring standards changed. Since dentures were ultrasonically cleaned at each visit after disclosing and scoring, light calculus deposits may have been removed. The 3- and 6- month intervals between examinations were probably not long enough for new deposits to regain baseline level. However, in the intervention group, numbers of dentures with calculus deposits dropped much further than in the control group, suggesting that more brushing (and possibly greater use of appropriate denture cleansers) had occurred. This inference is supported by data on denture plaque levels.

It may be useful to note that the fall in calculus deposits in the control group suggests that even an occasional ultrasonic cleansing of dentures would be beneficial. Some Community Dental Services already offer this facility to nursing homes.

Mature denture plaque was present at high levels at baseline, indicating that dentures had not been satisfactorily cleaned for many days, if not weeks. Levels were similar for dentures cleaned by subjects and by staff, as Merelie & Heyman (1992) had observed in their study. This reflected poorly on the standard of denture hygiene in the homes. Anecdotally, both staff and clients said that dentures were commonly rinsed before being placed in alkaline peroxide solution overnight. This was considered adequate, despite manufacturers' product instructions that the dentures be brushed before soaking. Subjects often knew that dentures were not clean and commented that when they lived independently, they achieved higher standards of

cleanliness. The deficiency was attributed to the fact that 'they only soak them here'. When ultrasonically cleaned dentures were replaced in subjects' mouths, many spontaneously commented that the dentures felt much better.

By the end of the trial, the descriptive analysis showed that in the intervention group, denture plaque levels were half those in the control group, irrespective of surface. The intervention group's improvement reflects the increase in reported levels of staff activity in denture cleansing and suggests that brushing rather than mere soaking was being practised. When data for subjects contributing at baseline and at subsequent visits were analysed to assess the intervention's efficacy, the same picture emerged. The benefit for the intervention group was highly significant at both follow-up visits, irrespective of surface. Even when the standard error was increased (about twofold) to adjust for cluster randomisation, the difference between the groups remained highly significant. The combination of information, demonstration and practice of denture hygiene during the health education session appears to have been successful in improving denture hygiene in the short- and longer-term. This finding supports those of Ambjørnsen & Rise (1985) and de Baat *et al.* (1993), that demonstration of cleaning techniques, rather than information alone, produces longer-term improvement in denture hygiene.

A number of studies in nursing homes have graded denture hygiene as satisfactory or unsatisfactory. Some researchers (Wilson *et al.*, 1987; Mersel, 1989; Stuck *et al.*, 1989; Merelie & Heyman, 1992; Knabe & Kram, 1997) did not describe their criteria, but gave values of 45-81% for the proportion of unsatisfactorily cleaned dentures. Ekelund (1988), without disclosing solution, found 72% of dentures with moderate or abundant plaque, a figure close to that found at baseline in the present study.

The study that appears most closely comparable to the present one was that of Pietrokovski *et al.* (1995). A similar 5-point scale was used, although it was not stated if disclosing solution was used. Pietrokovski *et al.* (1995) considered dentures unclean if they scored on the 3 highest scale points, and rated around 20% of upper dentures and around 30% of lower dentures unclean. Using a similar basis in this study for

categorising dentures as unhygienic (a mean denture plaque score of 2-4 on a 0-4 scale, equivalent to more than 25% of the surface covered in plaque), the proportion of unclean dentures in the intervention group fell markedly during the trial from 75.8% to 22.2%. These striking improvements in denture cleanliness were not mirrored in the control group, where denture plaque levels remained high. The scores recorded in this study at baseline for the intervention group and at all visits for the control group were higher than those seen by Pietrokovski *et al.* (1995). This can be explained by the use in this study of disclosing solution, which was likely to permit more accurate identification and scoring of plaque.

The most frequent shortcoming in the homes, reported in carers' questionnaires, was the lack of denture cleansers and toothbrushes. Denture hygiene in intervention group homes may have improved because of the emphasis placed during health education on the importance of mechanical plaque removal, and the distribution of toothbrushes for all the residents. However, it is a shortcoming within homes if adequate denture care materials are not provided, and one that has been noted elsewhere (Ekelund, 1988).

Denture-induced stomatitis levels at baseline (30%) were higher than those of around 20% reported in institutionalised populations by Jorge *et al.* (1991) and Merelie & Heyman (1992) but agreed with the findings of Schou *et al.* (1987, 1989), Pietrokovski *et al.* (1990a), Blair *et al.* (1995) and Knabe & Kram (1997). Higher levels around 40% have been reported by Pisanty *et al.* (1989) and Wilkieson *et al.* (1991). Interpretation of these denture-induced stomatitis levels has to take into account the fact that some denture wearers do not carry *C. albicans* and would not therefore develop a candidal infection. The proportion of denture wearing non-carriers in a healthy population was found by Arendorf & Walker (1979) to be around 30%, although it might be lower in an institutionalised population in poorer health. Spearman's rank correlation on baseline data showed that denture-induced stomatitis was strongly correlated to mucosal surface denture plaque. This relationship has been previously reported by Tarbet (1982), Vigild (1987) and Blair *et al.* (1995).

If the effect of the health promotion were to improve the cleanliness of denture surfaces, a corresponding reduction in denture-induced stomatitis levels could be expected at subsequent examinations. This proved to be the case. The 20% increase in the proportion of healthy intervention group subjects at visit 3 compared to baseline was similar to the 23% improvement reported by Vigild (1990) when evaluating an oral health service in a nursing home. In this study, the reduction in severity of denture-induced stomatitis and the fall in numbers of affected subjects in the intervention group reflected higher post-intervention standards of denture cleanliness. The progressive nature of the improvement may reflect the necessary time (3-4 weeks) for denture-induced stomatitis to resolve in the presence of improved denture hygiene but without specific anti-fungal therapy (Pindborg & Holmstrup, 1996). For the same reason, adjusted treatment differences for subjects contributing data to baseline and subsequent visits were greater and more highly significant at visit 3 than at visit 2.

6.2.2.7 Dental hygiene and associated conditions

The outcome measures most closely associated with dental hygiene were dental plaque and gingivitis, both of which showed improvements in the intervention group.

Plaque scores on natural teeth were high at baseline, reflecting the large number of subjects who reported inability to brush easily. A high proportion of subjects had no help from staff, despite living in an environment where all personal care requirements are assumed to be met. It was evident that homes were failing in their duty to provide the necessary oral care facilities for their clients. Many carers' commented in the questionnaires on the lack of oral care equipment, echoing Ekelund's (1988) finding of 43% of dentate clients without a tooth brush. It must be considered negligent if toothbrushes and toothpaste are not supplied and if clients are not enabled, encouraged or assisted to brush their teeth. Why should oral health care be treated in this way when, by comparison, clients without relatives to supply toiletries are routinely provided with soap and are washed daily?

Some clients were concerned for their natural teeth. A male subject said tearfully that he was very worried because his teeth felt as if they were 'covered in bits of paper'.

This was an accurate description of the appearance of thick, flocculated mature plaque and food debris covering his dentition. Since this subject had previously been a general medical practitioner, it may be assumed that either the effects of institutionalisation had reduced his assertiveness and prevented him from voicing his health concerns to staff or that, having voiced concern, his needs were ignored.

Both groups scored consistently higher for plaque on buccal than on lingual surfaces, in line with the pattern seen in the general population (Jenkins *et al.*, 1993). These high baseline plaque scores reflected the numbers of subjects who did not achieve or receive effective brushing. There was evidence of a Hawthorne effect that was subsequently lost. Changes in the control group were slight, but the reduction achieved in dental plaque levels in the intervention group one month after health education was in the order of 20%, which compares well with the average reduction of 18% reported in the review by Brown (1994) of oral health interventions among all age groups. The subsequent relapse in plaque levels at visit 3 was much smaller in the intervention group, which remained 14% better than at baseline, while the control group regressed to previous levels. When, in the analysis of efficacy, adjustment for minor baseline imbalances between groups had been made for subjects contributing data at baseline and subsequent visits, there were highly significant reductions in overall plaque at follow-up visits. The main component in this was the reduction on lingual surfaces, which suggests that, where staff began to help clients, oral health care advice about lingual surfaces had been heeded. After adjustment for cluster randomisation, highly significant differences were sustained for overall plaque levels and for lingual surfaces.

However, despite the intervention group's improvements, plaque levels remained higher than desired with average tooth coverage of over one-third of all surfaces.

Gingivitis scores showed both groups having consistently higher buccal than lingual scores, reflecting the pattern of dental plaque levels seen in the study and the overall pattern of gingivitis reported by Addy *et al.* (1987). Baseline gingival condition was poor, averaging a higher score than merely marginal inflammation. Progressive

improvement in the intervention group was especially marked on lingual surfaces, where the average visit 3 score was below the marginal gingivitis level score of 1. When the analysis of efficacy was performed on data for subjects participating in baseline and subsequent visits, group differences at visit 3 were highly significant for all combinations of segments and surfaces, and were robust enough to withstand adjustment for cluster randomisation.

The intervention group's gradual improvement may reflect the time taken in elderly subjects for gingivitis to regress once better oral hygiene has been established (Holm-Pedersen *et al.*, 1975). It may also indicate that it required longer than the 4-week interval between intervention and second examination for staff and patients to become more proficient in brushing. The improvement, in the order of 20% by the end of the trial, is encouraging, since in a similar study of nursing home clients, Vigild (1990) reported no effect on gingivitis levels. An important consequence of gingivitis is that it often progresses to periodontal disease. Anaerobic organisms associated with periodontal disease have been found in cases of aspiration pneumonia. This finding by Scannapieco & Mylotte (1996) prompted the authors to hypothesise that oral hygiene among nursing homes residents will be an important factor in controlling respiratory infection in the future. If that hypothesis proves to be correct, it would imply an even greater responsibility for nursing home staff to ensure that clients achieve effective levels of oral hygiene.

6.2.2.8 Outcomes measures distal to the intervention

As described in Chapter 4 Section 4.1.1, some outcome measures (calculus, cervical/root caries and tooth mobility) were not expected to be significantly influenced by the intervention alone, since they would not be expected to improve without professional dental treatment. These variables were recorded, therefore, as indicators of the incidence of new disease.

Dental calculus levels did not change appreciably during the trial (suggesting that much of the deposition had occurred over a longer time scale) and differences between the groups were not significant. Small fluctuations in median values may

reflect examiner variation in calculus recording, which sometimes took place under tiring conditions for subjects. One-third of tooth surfaces had calculus deposits and only 17-19% of subjects were calculus-free. This level is markedly lower than Fiske & Lloyd's (1992) report of 72% without calculus but considerably higher than Vigild's (1988) report of 5% calculus-free dentate institutionalised individuals. The wide variation between these studies may be an indication of the problems of assessing calculus in an epidemiological rather than a surgery setting.

As much buccal as lingual calculus was recorded. Normally, the distribution of calculus is greatest lingual to the lower anterior teeth and buccal to the upper posterior teeth, being greatly influenced by proximity to the openings of salivary ducts (Alexander, 1971). Therefore, the increased labial and buccal distribution reflects the minimal toothbrushing activity by subjects, perhaps over a prolonged period, and the wide neglect of dental hygiene and dental treatment in nursing homes. Removal of calcified deposits requires professional treatment. Indeed, Beck (1984) noted presence of calculus as the only variable affected by recent dental treatment. The persistence of deposits supports clients' reports that little, if any, professional treatment was carried out during the study period.

Cervical and root caries at baseline affected 4% of surfaces in the intervention group and 9% in the control group, the latter value being close to the 10% level, reported by Strayer (1993) among homebound elderly. Median values for the control group were at all times approximately twice those for the intervention group. There is no obvious explanation for this imbalance, apart from chance. Although the incidence of root caries increases as calculus amounts increase and as the number of teeth decreases (Kitamura *et al.*, 1986), both groups had similar overall calculus scores and mean numbers of teeth. The control group was more likely to have seen a dentist within the last year, which makes the group difference even harder to explain. As the trial continued, median values for each group doubled, but at no time were the group differences significant. Most of the increase in caries occurred buccally rather than lingually, which was consistent with other researchers' findings (Katz *et al.*, 1982;

Kitamura *et al.*, 1986) and may be associated with the higher observed buccal plaque levels.

The principal reason for this increase appears to be the susceptibility of the clients and the absence of professional dental care provision, confirmed by clients' responses to the question about their last dental visit. However, subjects recruited after baseline appear in the descriptive analysis, so that the increase in cervical/root caries may not be due solely to individuals having spent longer in an institution. It may be that newer residents, as nursing staff believed, were more dependent by the time they were admitted, had been coping poorly with their oral health care for some time previously and had consequently experienced higher levels of dental disease.

Tooth mobility was not influenced by the intervention and differences between the groups were not significant. As might be expected, the proportion of mobile teeth increased slightly over the trial as subjects' experience of disease and less than optimal plaque and gingivitis levels lengthened.

6.2.2.9 Statistical considerations

6.2.2.9.1 The effect of cluster randomisation analysis on confidence intervals and p values

The statistical adjustment for cluster randomisation imputed a standard error to the difference between the means of the two allocation groups, making allowance for the likelihood of between-cluster variation exceeding the expected within-cluster variation. Since the standard error is a factor in the calculation of confidence intervals, any increase in standard error widens the confidence interval.

For denture plaque, the adjusted standard error was approximately twice the unadjusted value, and had the effect of widening the 95% confidence interval by between 0.30 and 0.38 units for buccal surfaces, mucosal surfaces and all surfaces

combined at both visit 2 and visit 3. Nevertheless, the widened confidence intervals did not include zero, and statistical significance remained high.

The adjusted standard errors for other variables (dental plaque, gingivitis, cervical/root caries, calculus and tooth mobility) remained very close to the unadjusted values, so that confidence intervals widened only marginally. This did not cause any alteration where p values were already highly significant. Thus, differences between allocation groups remained highly significant for dental plaque on all surfaces and on lingual surfaces at both visit 2 and visit 3, and for gingivitis on all surfaces and all combinations of segments and surfaces at visit 3. However, where p values for unadjusted differences in means were between 0.05 and 0.02, the slight widening of confidence intervals was sufficient to encompass zero. Probability values therefore rose above the 5% level of significance for buccal dental plaque levels at visits 2 and 3 and for most gingivitis levels at visit 2.

The remaining variables (cervical/root caries, calculus and tooth mobility at visits 2 and 3) remained non-significant at the 5% level, as they had been before cluster randomisation adjustment.

Thus, only highly significant p values of ≤ 0.003 were robust enough to survive adjustment for cluster randomisation analysis.

6.2.2.9.2 The effect of multiple comparisons

Because multiple comparisons were made, caution was necessary in interpreting p values. There was a high probability that 5% would be significant just by chance, even when there was no real difference. Thus p values around the 0.05 level had to be viewed with care. However, out of 28 variables analysed, both unadjusted and adjusted for cluster randomisation, 14 had p values of ≤ 0.001. There was clear evidence of differences occurring that showed benefit to the intervention group, and the global null hypothesis was therefore not tenable.

6.3 Discussion of findings of carers' survey

6.3.1 Response rates and staffing levels

Response rates of around 80% are widely considered desirable to give adequate representation of the study sample. That rate was achieved at the first 2 visits, although it fell slightly at visit 3. Some carers responded at one visit but not at previous or subsequent visits, some never replied while others left the homes during the trial. In order to maximise the response rate, a reminder and another copy of the questionnaire were sent via the matron to non-responders. In the case of one home, where the response rate had been very low, possibly as a result of the internal financial and managerial problems experienced there during the trial period, a second reminder was sent after visit 2. These efforts were partially successful in prompting responses. Further efforts to improve the response rate were likely to have been unproductive, and might have antagonised the non-responders.

It was not possible to assess the characteristics of non-responders, since no data on them were available. It would only have been possible to obtain personal data about them by, for example, interviewing them at work at a later date; this would have involved a large number of extra visits to cover all shifts, and would not have been practicable within the time schedule of the trial. Even when data on non-responders are available, they are usually confined to a few demographic variables that may or may not be associated with the topic of the questionnaire. Even if a demographic bias is detected, it yields no information about bias in opinions or behaviour. In such situations, as Oppenheim (1992) discussed, it is not usually possible to estimate whether the reasons for non-response were internal factors connected with the topic of the survey or unconnected external factors.

Since the response rate in this study was high, the effect on the data was less than it would have been had the response rate been low. In addition, partial data were retained in the analyses, lest discarding incomplete records should have lead to an inadvertent bias. This did not cause any statistical problems, since correlations

between different variables were not calculated. However, a high response rate is no guarantee against bias (Oppenheim, 1992) and non-responders are likely to differ from responders in certain ways. Oppenheim (1992) reflected on whether people with, for example, a drinking problem, were less or more likely to answer a questionnaire on alcohol consumption. Roberts *et al.* (1996), in a lifestyle study, found non-responders to be a very elusive group. Those who were contacted did not form a representative sample of all non-responders, although they seemed less likely than responders to follow a healthy lifestyle. Perhaps the non-responders in this study also had less positive health attitudes and behaviour. If that were the case, the scores for carers' knowledge and attitudes might have been lower had the non-responders returned questionnaires. Alternatively, they may simply have been less sympathetic to requests to complete questionnaires or too busy to comply. A contrasting finding was reported by Herriman & Kerschbaum (1990), who found that, at an institutional level, there were no significant differences in the characteristics of responding and non-responding nursing homes in Minnesota.

Staffing levels fell by about 22% during the trial. Matrons attributed this to several new, large nursing homes opening in the Health Authority area. New homes competed with existing homes for the same number of potential clients and a finite pool of people interested in working as care assistants. Staff who left could not always be replaced, making greater demands on those remaining. This may explain the lower response rate at visit 3. Alternatively, carers had perhaps tired of completing the same questionnaire for a third time, or matrons had become less assiduous at collecting forms.

6.3.2 Demographic characteristics

The small numbers of carers over 55 years of age reflected difficulties with the physical demands of the job, particularly lifting clients. The overwhelming majority of female carers reflected women's traditional caring role within families and the low-status low-pay employment.

In the geographical area studied, staff turnover was lower than rates quoted for the United States (60% by Kaz & Schuchman, 1988; 32% by Banaszak-Holl & Hines, 1996). During the first two visits, around 12% of care assistants had joined the home within the previous year. However, as staff levels fell towards the end of the trial, turnover dropped, so that, by visit 3, only around 3.5% of carers had less than a year's experience. Improvements in oral health care practice were thus more likely to be maintained than when staff turnover was high.

Both groups reported high levels of dental attendance. Approximately 90% claimed to be registered with a general dental practitioner. However, only two-thirds reported attendance at least once a year for examination. These attendance patterns are nevertheless considerably higher than 50%, the proportion of adults having regular check-ups reported in the 1988 Adult Health Survey (Todd & Lader, 1991) and contradict the impression given by carers' comments in questionnaires that increasing charges for dental care were posing a barrier to many wishing to seek treatment. The figures for reported active registration with a dentist are also higher than the 51-56% levels for adults aged 18-54 currently recorded in southern England (Dental Practice Board, 1997). Reported attendance patterns in this study may reflect over-optimistic reporting or misunderstanding of the criteria for registration. Confusion may have arisen because of the different mechanisms for medical and dental registration. Whereas registration with a general medical practitioner continues unless notice is given by either party, dental registration may lapse after a relatively short time if the patient has not attended during the prescribed period. Patient are often not notified of de-registration and may be unaware it has happened.

6.3.3 Carers' knowledge levels

Significant independent predictors of knowledge scores were identified as age and dental attendance pattern. Carers aged 26-35 had lower knowledge scores than any other age group. It is difficult to suggest a reason other than chance for their oral health care knowledge being poorer than their colleagues. As the age group most likely to have young children, they may find that combining a tiring job with the demands of a young family leaves them with insufficient mental energy to assimilate

oral health messages from whatever source. By comparison, the 36-45 age group scored highly on dental care. Perhaps, as the parents of older children, they have spent more time taking offspring for dental appointments, and have received greater exposure to oral health messages.

Not unexpectedly, carers with a regular dental attendance pattern had significantly higher knowledge scores than other groups. They are the individuals likely to have received the greatest exposure to oral health advice. Alternatively, the reverse causality may apply if having greater knowledge predisposes individuals to attend more regularly.

Knowledge levels on denture care could be considered fairly satisfactory in many aspects, since two-thirds of statements were correctly categorised by at least 70% of respondents at each visit. Nevertheless, knowledge was not always put into practice, as was evident from the clinical results. Generally, the control group throughout the trial and the intervention group at baseline did not:

(i) routinely brush dentures although they knew that soaking alone was inadequate and that unclean dentures could cause problems;

(ii) rinse dentures after meals although they knew it was advisable in order to improve clients' comfort.

Following health education, the information that appears to have had the greatest impact was that thorough brushing is a more effective cleansing method than soaking in most chemical denture cleansing solutions, a topic about which Cardash *et al.*(1989) found auxiliary staff ignorant. Whereas only around half the carers in either group at baseline appreciated this fact, almost 80% of the intervention group were aware of it by visit 3. This improvement in knowledge level was reflected in the improvement in hygiene of the intervention group clients' dentures.

Both groups improved their responses regarding the need for regular dental examination of edentulous subjects. Improvement in the control group was probably due to questionnaire administration alone raising dental awareness. As one carer

commented in her baseline questionnaire, 'This survey has given me an insight into how much there is to learn....' The intervention group's 50% improvement in responses over baseline was twice that in the control group. This suggests a benefit from the health education. The knowledge change did not manifest itself in practice, since the proportion of clients offered a dental check-up did not increase. However, that type of policy decision is likely to rest with management and to be beyond care assistants' limited sphere of influence. Hoad-Reddick & Heath (1993) reported similar findings; although carers in their survey had high levels of knowledge about the importance of regular checks for denture wearers, knowledge was not translated into action, the majority of homes in their survey only calling dentists in response to specific clients' problems.

For the statement concerning the frequently painless nature of denture-induced stomatitis, the intervention group doubled its percentage of correct responses after health education, although knowledge levels were, at 22%, still very low.

Another topic on which knowledge levels remained low concerned the increase in oral bacteria that accompanies denture wear. Correct responses remained steady at 40-50% in both groups throughout the trial. The topic was included in the health education sessions, but the message appeared to make little impact. However, it was perhaps less important than practical information about denture cleansing.

Knowledge levels on care of dentate clients were not as high as those for denture care. This may reflect either carers' experience with a predominantly edentulous clientele or uncertainty due to ambiguously worded statements. For only five of fifteen statements did correct responses reach the 70% level at baseline. These statements referred to the beneficial effect of oral hygiene on gingival condition, the relationship of dietary sugar and bacteria to caries, the advisability of wearing protective gloves when cleaning inside clients' mouths and the continuing susceptibility to caries in old age. Despite good awareness of this last topic, less than two-thirds of carers in either group understood that xerostomia might increase caries susceptibility and less than one third realised that elderly people could be at greater risk of caries than younger

age groups. Nearly all respondents continued to believe that lack of calcium predisposed individuals to caries and two-thirds continued to believe that a tendency to suffer caries was inherited, and therefore by implication, not preventable. Since levels of cervical/root caries doubled in both client groups during the trial, the subject of caries in old age needs to be better publicised. It was disappointing that, despite the inclusion of all the questionnaire topics during health education, about one-third of intervention group carers continued to believe that a mouth-swab was an effective implement, and that gum disease would alert sufferers to its presence by causing pain.

Following the health education, improvements in the intervention group's knowledge levels occurred for statements relating to the lesser efficiency of a large-headed toothbrush compared to a small-headed brush, the fact that elderly people are not at lesser risk of caries than younger age groups and the possibility of cross-infection from clients' saliva. Control group responses remained at the same level as at baseline. Group differences reached statistical significance for the toothbrush statement at visit 2 although not at visit 3, and for the other two statements solely at visit 3.

Aggregated knowledge scores showed that the percentage of correct replies at baseline was around 70% for denture care and 60% for care of dentate clients. These levels are comparable to those of 50-75% found among nurses and carers of mentally handicapped individuals in the UK (Davies & Whittle, 1990; Rak & Warren, 1990) and among nurses and care assistants in the USA (Logan *et al.*, 1991; Glassman *et al.*, 1994). By visit 3, both groups had a higher mean score, perhaps because the questionnaire had prompted them to think more deeply about oral care. Although there were few significant changes for individual questions, the composite knowledge scores did reveal highly significant differences between allocation groups at visits 2 and 3. Between baseline and the end of the trial, the control group's knowledge level for denture care improved by 5.5% while the intervention group improved by around 9.5%. Between baseline and the end of the trial, the control group improved its dental care knowledge level by 0.5% and the intervention group by 6.8%. Figures were

almost identical for both the carers working at the time of the intervention and the total sample, including carers joining homes later.

This similarity between the two differently constituted bodies of carers may be explained by the considerable overlap between those carers present both at baseline and during the intervention period and the total number of carers responding at each time point. Carers likely to have been working at the time of the intervention comprised around 70% of the total number of carers at baseline, 88% of the total carers at visit 2 and around 82% of the total carers at visit 3. Nevertheless, when mean total knowledge scores were compared, the slightly lower p values for the 'all carers' group, compared to the body of carers likely to have been working during the intervention, suggests that the intervention may have had a residual effect in the homes. The mechanism for the residual effect may have been the training pattern within many homes, where a new carer shadows a more experienced one. Where carers benefiting from the health education were performing more effective oral health care, their improved practice would be passed on to new staff. Alternatively, there may have been a change in guidelines or policy within homes as a result of the health education. Data were not collected on policy change, although when homes were contacted with feedback about the study findings (after all data collection and analysis were completed), some matrons commented that they now carried out dental care differently since they had received the health education. Comments included:

> 'It has completely changed the way we do oral care. It means a lot more to us than it ever did before. Now that the girls know what they should be doing and why, they are much more interested and much more thorough. It's really changed how we think about teeth.'

> 'Interest has been sustained to this day. I notice a lot more oral care going on in the home and you hear people saying "So-and-so needs a new toothbrush." And we change tooth brushes regularly now.'

However, the residual effect should be cautiously interpreted, since it may only have been an apparent phenomenon, which could be explained by the recruitment of new staff with higher existing levels of oral health knowledge.

The increases in knowledge levels were modest compared to the 25-32% improvement after an education programme reported by Glassman *et al.* (1994) for

community carers of disabled people. However, Glassman's sample started from a lower baseline of 55% and his programme was 6 times longer than that of the present study. Certainly, a greater improvement in knowledge levels had been hoped for when planning this study. However, recorded baseline knowledge levels were higher than had been anticipated. The results may therefore indicate a 'ceiling effect', where it is difficult to raise levels further.

6.3.4 Carers' responses to attitude statements

Age and dental attendance pattern were significant independent predictors of attitude scores. In contrast to their low knowledge scores, the 26-35 age group scored significantly higher than other age groups for statements on clients' oral health and for total attitude score. Their positive attitude may be due either to chance or to this age group having sufficient experience of life to believe they can influence events, while not encountering too many setbacks to disillusion them. Alternatively, it may be another facet of people likely to be parents of young children, that they are positively inclined to oral health because they are keen to keep their children's teeth healthy.

Unsurprisingly, regular dental attenders had markedly more positive attitudes than irregular attenders, both regarding their own and clients' oral health. It is difficult to estimate whether holding of positive feelings towards oral health influences individuals to make active efforts to maintain professional dental care, or whether the reverse is true.

For **clients' oral health care**, over 85% of carers held positive attitudes to 9 of 13 statements. The majority of responses indicated that carers saw oral health care as part of their role, and that they understood the importance of the preventive element of that role with regard to caries and periodontal disease. They also supported the principle of regular dental check-ups as a routine measure for clients.

For four statements, baseline attitudes were less positive. Whereas, for these statements, the control group's responses remained fairly similar throughout the trial, the intervention group's responses became progressively more positive. Between 11%

and 15% more carers in the intervention group gave positive responses to these four statements at visit 3 compared to baseline, although only two (those referring to the belief that the dentist is the sole preventive influence on periodontal disease and to feeling uncertain about brushing correctly) reached statistical significance. Group differences for two other statements failed to reach statistical significance, despite a more positive shift in intervention group attitudes; these statements referred to feeling uncomfortable with oral care and about the need to increase brushing activity when clients' gums bled. This last attitude was, however, still only held by around 40% of intervention group carers after health education; the low proportion of positive responses may indicate that the relevant health education message needed to be presented with greater emphasis, or it may reflect a deep-seated reaction by carers to stop causing a phenomenon (bleeding) which they perceive as undesirable. A similar question in Rak & Warren's (1990) questionnaire also resulted in a majority of nurses indicating that their response to gingival bleeding would be to stop brushing. The way that information on this topic is communicated clearly needs further consideration.

The main effect of the health education intervention appears from these findings to have been to influence attitudes positively concerning carers' appreciation that their actions may affect dependent clients' oral health in addition to any professional dental care received, and to enable a significantly greater number of carers to feel more confident about brushing clients' teeth.

For **carers' own oral health**, more than 75% of respondents held positive attitudes for just over half the statements. Subjects about which they felt ambivalent or less positive included whether they were satisfied with the way they had looked after their teeth, the degree to which the onus of preventing dental problems was felt to rest with the dentist rather than the patient, and the degree to which gingival bleeding reflected ineffective self-care. The most negative responses were those regarding tooth loss, around two-thirds of carers believing that it was an inevitable accompaniment of growing older. The health education seemed to have had a positive effect in persuading an increasing majority of intervention group carers that retention of natural teeth was preferable to wearing dentures; 21% more positive responses came from the

intervention group at visit 3 compared to baseline, while the control group showed little change.

Aggregate attitude scores were calculated such that a score of zero indicated neutrality, while the maximum positive score was +26 and the minimum negative score was -26. Baseline attitude levels were mildly positive, and comparable to those in a study by Wallace *et al.* (1997) in the USA. Surveying a group of nurses caring for chemotherapy patients, Wallace found favourable attitudes towards performing oral care for patients, with a mean attitude value of 3.7 on a 1-5 Likert scale, where high scores were more positive. In the present study, averaging individuals' mean baseline score over their number of responses gives a value of 0.8 on the +2 to -2 scale, similar to that of Wallace *et al.* (1997) on their 1-5 scale. A similar calculation on responses to carers' own oral health, not assessed by Wallace *et al.* (1997), gave a slightly less positive average per statement score of 0.6.

Other researchers' attitude scales have not provided equivalent information. Kaz & Schuchman (1988) derived a score but did not state the minimum and maximum possible. Quinn & Freeman (1991) and Diu & Gelbier (1987) gave percentage responses for health visitors and doctors respectively, while Fiske & Lloyd (1992) reported that in residential homes, 'overall carers' attitudes to their own and residents' oral health were positive'. In the study by Chalmers *et al.* (1996), the majority of carers (90%) rated oral care as an important form of assistance that should be given to clients.

In the present study, the proportion of overall positive responses (those scoring +1 or +2) did not appear to change greatly during the trial period, yet total attitude scores in the intervention group did improve, indicating that more carers were choosing more strongly positive options than they had prior to the health education. Control group responses became less positive as the trial progressed, possibly due to boredom with completing three identical questionnaires without having had the benefit of oral health education to place the questions in context. Differences in the groups' attitude scores increased at visits 2 and 3, and became moderately to highly significant.

It was interesting to relate attitude to behaviour. A previous study by Kahana & Kiyak (1984) found that, in facilities for the elderly, staff attitudes and behaviour were often unrelated, being influenced more by the demands of a particular situation or role than by attitude. However, this study shows that, at least during the 6 months following the health promotion, both attitudes and behaviour among carers changed favourably towards oral health care. When the intervention was introduced, carers were on a point on the knowledge-behaviour continuum (Blinkhorn, 1981) where they were only partially aware of how clients' oral health care needs should be met. Many had indicated in responses to open-ended questions that they thought oral health care should be more assiduously carried out, but having received no training, they were unaware of how improvement might be achieved. Once carers had improved oral health knowledge and skills, their attitudes became more positive and their concern for the well-being of their clients appears to have motivated them to change the way they performed oral health care.

Periodic reinforcement of health education messages is always necessary, since the effects of any intervention are very likely to wane with the passing of time. However, in this study there was little evidence of that happening six months after the intervention. As fading increases over a longer period and as staff turnover inevitably occurs, it seems likely that an annual reinforcement would be an effective and economic choice in order to maintain the beneficial effects of the health education.

6.3.5 Carers' responses to open-ended questions

Carers' own comments, prompted in the questionnaire, provided subtle insights into nursing home practice that an outsider might miss. The majority of comments concerned shortcomings in policy and practice within the homes. Although carers were aware of deficiencies in oral health care, often feeling strongly about them, they were not empowered to change the situation. In bemoaning the lack of staff training, the widespread lack of personal oral care materials and of regular dental examinations, carers recognised that the management placed a low priority on oral health. Indeed, some carers were openly critical of qualified staff during the health education

sessions. Failure among nursing and allied staff to prioritise oral health, especially among the elderly, is a frequent finding in surveys and reviews, including Schweiger *et al.* (1980), Ley & Langsjoen (1985), Pietrokovski *et al.* (1990b) Rak & Warren (1990), Logan *et al.* (1991) and Eadie & Schou (1992).

Many carers noticed that their colleagues performed oral care perfunctorily, as authors including DeWalt (1975) and Blaney (1986) have noted. Oral care is a common corner to cut among experienced carers (Chalmers *et al.*, 1996). This attitude undoubtedly exerts peer group pressure on others to skimp oral care. Some carers in this and in other studies have used maintenance of clients' independence as a reason to stand back from oral health care, assuming no wish or need for help unless clients specifically requested it. However, many clients become institutionalised, and have been reported passively to accept the minimum care offered (Dolinsky & Dolinsky, 1984; Vogel & Mercier, 1991; Wårdh *et al.*, 1997). In the absence of accurate needs assessment, client autonomy is often used as an excuse for carers' inactivity, a fact noted by Hallett (1984) and Kambhu & Levy (1993).

Despite quite a number of negative views from a personal viewpoint about the quality of dental care in the UK, carers generally held positive views about the concept of oral health care, echoing the findings of Fiske & Lloyd (1992) and Chalmers *et al.* (1996) and confirming their attitude scores in the present study. They accepted responsibility for overseeing clients' oral health care, recognised the need for training and expressed interest in learning more.

6.3.6 Assessment of the health education sessions

Carers' reactions were generally very favourable. The material was assessed as interesting, comprehensible and appropriate to carers' needs. The Health Promoter found that, with few exceptions, the carers appeared to enjoy the sessions and find them useful. The attendance certificates proved very popular, and appeared to enhance carers' self-esteem. For most parameters, over 95% of participants rated the training favourably or very favourably. Similar levels of approval for were received by

Munday & Gelbier (1984) in the UK and Glassman *et al.* (1994) in the USA for their programmes with nurses and carers.

However, the majority of carers thought that the material had been presented a little faster than they would have liked. Although the information had been reduced to what the researcher and Health Promoter considered a minimum to ensure understanding of simple oral health care, rather than just dealing with the mechanics of the task, a slightly more leisurely presentation would have been beneficial. In particular, the Health Promoter felt that carers were at times distracted by the sounds of nursing home life continuing outside the presentation room. Sometimes, carers were called away to attend to clients, or were keen to leave because their shift had ended.

On-site training had been selected as most likely to appeal to matrons in terms of minimising the time and cost of releasing staff. It was also expected to appeal to staff because it would minimise the effort and inconvenience to themselves. If courses took place outside the workplace, there might be financial restraints on those wishing to attend. Extra staff would be needed to cover duties for those attending the course. This would place an extra financial burden on the nursing home, and course participants might not be reimbursed for their time or travelling expenses. The problem would probably be most acute in small homes, where Todd (1990) noted that funding was especially tight. Nonetheless, the Health Promoter considered that, for some groups of carers, an independent venue might offer a calmer setting for future sessions.

Around the time that the intervention group's health education sessions were completed, Woodall (1997) published a paper describing another programme of oral health education for nursing home carers in the UK. On-site training had been subject to pressures of work and interruptions. A 3-hour training session was therefore organised at a pleasant central venue and participant satisfaction had been very positive. The findings of the present study suggest that Woodall's (1997) conclusions should be balanced against the arguments for on-site training when venues for carers' health education are being planned.

The mean cost per client of delivering the health education intervention was £3.25. For this modest sum, the client was likely to benefit from a reduction of over 40% in denture plaque and a 20% reduction in mucosal lesions associated with unhygienic dentures. If dentate, the client would be likely to enjoy reductions in dental plaque and gingivitis of around 20%. Both these improvements on oral health could be expected to increase the comfort and well-being of the client.

Since the effect of the intervention had been largely sustained for 6 months following the intervention, it was estimated that annual oral health education would probably represent an appropriate frequency in order to reinforce the desired information and maintain a reasonable level of awareness of oral health within the homes. Based on this assumption, the projected cost of extending the programme to cover all nursing homes in the Health Authority area, taking into account the likely depreciation of the visual teaching aids, would, at around £6,000, represent a modest proportion of an annual health promotion budget for which a clinically relevant health benefit could be expected.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

Introduction

A number of issues arise as a result of this study. The first relates to the pre-existing levels of nursing home clients' oral health and the second to arrangements for provision for oral health care in these institutions. Another issue concerns the effectiveness of the oral health care intervention. The lessons learned during the trial and the generalisability of the results need to be considered when making recommendations for implementing the research findings. Finally, the overall conclusions lead to the formulation of ideas for taking forward this area of research.

7.1 Existing levels of oral health among nursing home clients in Avon

The overall levels of oral health at baseline were depressingly low, which only served to confirm the findings of many other researchers including Vigild (1987, 1988), Ekelund (1988), Merelie & Heyman (1992), Jokstad *et al.* (1996) and Knabe & Kram (1997). Plaque covered the majority of denture and natural tooth surfaces. As a result, levels of mucosal pathoses and gingivitis were high. Calculus and untreated root caries were frequent findings, indicating that professional dental care was not taking place. Despite the fact that elderly people are at greater risk of dental disease (Holm-Pedersen *et al.*, 1975; Katz *et al.*, 1996), only 13% recalled a dental consultation during the previous year. It is a sad reflection of the neglect of oral health in an environment where complete care of the individual is assumed and expected. Elderly people cannot be relied on to perform denture or dental hygiene effectively, even when living independently (Smith & Sheiham, 1979). How much worse their ability for oral hygiene is likely to be when, as in the present study, they are disabled to the extent that up to 70% of clients were unable to walk, even with assistance.

7.2 Existing levels of oral health care provision in nursing homes

7.2.1 Carer-assisted oral health care

The majority of clients required assistance with oral hygiene. Of these, none of the dentate clients and only 78% of denture wearers received help from staff. This indicates a failure to assess clients' oral health needs adequately, and supports the findings of researchers' such as Hoad-Reddick (1992), Kambhu & Levy (1993) and Henry (1995). Clients often regretted the lack of assistance with oral health care, but were unlikely to request help, since many perceived the carers as being too busy to do anything further. One can only conclude that this behaviour is typical of the complicit acceptance of inadequate care that has been observed elsewhere in nursing homes (Pearson *et al.*, 1993; Grau *et al.*, 1995).

7.2.2 Behind the scenes: what carers revealed about oral health care

Carers' responses to open-ended questions provided useful additional insights on oral health care, which a visitor to the home might easily overlook. Their responses revealed worries about management's lack of clear policy, other carers' casual approach to oral health care, and the universal lack of training. The lack of routine provision by the home of toothbrushes, toothpaste and denture cleaning materials was somewhat surprising. Presumably, this abrogation of responsibility does not extend to other necessities, such as soap, bedding and cutlery. Oral care was obviously a low priority, as many other researchers have remarked before, including Ekelund (1991), Hoad-Reddick (1992) and Soh (1992).

7.3 Effectiveness of oral health education

7.3.1 Impact on clients' oral health status

The most striking effect in the intervention group was the marked improvement in clients' denture plaque levels. Even when conservatively interpreted, the differences in group means were highly significant for all combinations of surfaces at both follow-up visits. There was also a highly significant reduction in denture-induced stomatitis in the intervention group at visit 3. Oral health benefits became more pronounced by the final visit, 6-7 months after health education. This suggests that skills improved and became more widely employed over a longer term than is often used for evaluation purposes. Education about denture hygiene can therefore be considered a successful intervention.

Changes among the intervention group's dentate subjects were less marked, although for some variables, statistical significance was high, even using conservative estimates. Differences in the groups' overall dental plaque levels were highly significant at both follow-up visits, as were the most conservative estimates for all gingivitis parameters by visit 3. The improvements in the intervention group were pleasing, although levels of dental hygiene still left much to be desired. Despite plaque scores in the intervention group decreasing by 15%, residual plaque levels remained higher than hoped for at 1.83. This represented between one- and two-thirds mean coverage of tooth surfaces, which clearly indicates inadequate hygiene. Improvement seemed to be partly due to carers' increased involvement in oral health care. However, it was also partly due to clients' increased self-caring activity. This latter phenomenon appears to have resulted from carers offering clients a more regular opportunity to brush their teeth, possibly because carers' awareness of oral health matters had been raised or because the provision of oral hygiene materials as part of the health education programme had improved their availability. Although around 22% more intervention group clients received help with toothbrushing, there are obviously persistent barriers to more general assistance being given, which the health education intervention did not overcome.

For the variables where reductions in mean values were unlikely without professional dental treatment (cervical/root caries, calculus and tooth mobility), there were no significant differences between group means. This indicates that, despite evidence of increased oral care activity among staff, the intervention did not affect the existing pattern of dental consultation as a mainly problem-solving measure. Requesting a dentist to call would be the responsibility of the qualified nursing staff. They appear to have taken little action. If oral health care were covered in nursing school curricula, nurses might, at an impressionable time in their training, become more aware of the advisability of regular dental care for patients in long-term care.

7.3.2 Impact on carers' oral health knowledge and attitudes

The health education intervention was very well received, and appears to have succeeded in its aims of significantly increasing knowledge, encouraging more positive attitudes to oral health and promoting changes in oral health care behaviour sufficient to achieve a significant improvement in clients' oral health. Differences in knowledge and attitude scores between the intervention and control groups reached statistical significance for the majority of outcome measures covering these aspects of the study. Improved knowledge and more positive attitudes to oral care are pre-requisites to behavioural change, which the clinical data indicate did take place.

7.4 Generalisability of the study's findings

It is reasonable to expect that the results of the study can be applied to other nursing homes registered with the Avon Health Authority, since care was taken to ensure that the sample was representative of homes in the entire area. The homes were randomly selected, none refused to participate, and a moderate number of small clusters, rather than a small number of large clusters, was selected. Within the homes, the number of clients and carers taking part in the study was large enough to minimise sample variation, while refusals and non-responders formed only a small proportion of the sample. This study also overcomes other principal factors that diminish the generalisability of a great number of health education trials, such as short follow-up

periods of one month or less and lack of a control group (Brown, 1994). In avoiding these pitfalls, the results of this study are likely to be more robust.

The study results are likely also to be generalisable over larger parts of the country. There are no 'league tables' to indicate the achievement of designated nursing home standards in different regions, so national comparisons are unavailable. However, it seems likely that Avon Health Authority nursing homes are fairly typical of similar establishments in southern England, and possibly of other regions of the UK. Nevertheless, cultural and geographical differences may result in some areas of the UK being more resistant to oral health promotion programmes, as Eadie & Schou (1992) discovered in Scotland.

7.5 Recommendations for implementing research findings

Overall, the oral health education programme may be considered a success, and its wider use as a method of in-service training can be recommended. The general enthusiasm with which matrons agreed to take part in the study, together with the favourable response from the majority of participants, should encourage members of the dental team to become involved in this neglected area of health education.

The extended period over which improvements in clients' oral health were maintained suggests that reinforcement intervals should not be too arduous, and are likely to be in the order of once a year, depending on local turnover rates for care staff. The option of holding health education sessions at neutral venues as well as in the workplace should be borne in mind, especially if difficulties, such as those described by Woodall (1997), are encountered.

Involvement of local nursing home registration and inspection personnel is advised. Their approval for the programme would not only help to reassure the homes that are

approached, but their espousal of the cause of oral health would help to raise awareness of the higher priority that it deserves in formal care settings.

The Community Dental Service (CDS) may be in the best position to train carers, since part of its mandate is to provide oral health promotion and prevention programmes (Health Services Guidance [97]4). Unfortunately, some health promotion services may be jeopardised by the current insidious and progressive financial cuts to the CDS.

Other environments where a similar oral health education programme is likely to be beneficial include community homes for people with learning disabilities and hospital wards for geriatric patients and others with disabilities. It may also be applicable to carers of functionally dependent homebound individuals.

Although this study concentrated on training less skilled staff, it should be the aim of the dental profession to influence the thinking of staff with greater executive functions. Both in this study and in others (Lewis, 1984; Lloyd, 1990; Stephens, 1997; Longhurst, 1998), nurses have recognised that their oral health training was deficient and that clients' oral care was neglected. Many nurses have expressed the wish to be taught by dental experts. Research evidence of this expressed need for adequate training and of the benefits that may accrue to clients when staff have received that training should be used to put pressure on nursing schools to ensure that routine professional dental input into nurse training courses is the norm rather than, as at present, the exception. Nurses might then accord oral health care a higher priority, practise it more regularly and teach auxiliary staff to carry it out on a daily basis in all nurse-regulated care settings. Regular workplace updating should also be carried out to maintain the priority of good oral care and to prevent its practice from lapsing.

7.6 Suggestions for further research

7.6.1 Investigating carers' reluctance to provide intraoral care

Some carers' responses to open-ended questions suggested that dentate clients were usually assumed to be capable of self-care with regard to oral hygiene, and that this assumed independence was considered critical to clients' self-esteem. Certainly, the client's preferences must be taken into account. However, carers' opinions may mask a psychological perception of the mouth as a private area or a boundary between the inside and the outside of the body that should not be transgressed (Fiske & Lloyd, 1992; Weeks & Fiske, 1994; Nettleton, 1995). Alternatively, it may be a rationalisation of carers' distaste for working inside the mouth. Support for both theories comes from the observation that toothbrushing simulation was the least popular part of the oral health education sessions. This area seems worthy of further investigation, perhaps in collaboration with researchers trained in clinical psychology or anthropology.

7.6.2 Multidisciplinary assessment of individual clients' oral health care needs

Nursing home staff are not generally aware of the need, when forming a plan for daily care, to assess clients' abilities and needs regarding oral health care. The issue of whether clients should be assisted is often confused by staff excusing their lack of involvement because they are respecting the wishes of the client. Kambhu & Levy (1993) suggested 'substantial individualising of approach and decision making.' This could be a valuable avenue for future research.

Allied to this, another area that could be researched is the effectiveness of assessing clients' dexterity and ability for oral self-care, preferably on admission to the nursing home. Where clients are discharged directly from hospital to nursing home, a detailed care programme for each individual is agreed; the effectiveness of incorporating an oral self-care assessment into the discharge programme merits investigation. It would also be useful to quantify appropriate intervals for reassessment during the clients'

residence in the home, so that any significant decrease in self-caring ability could be readily identified.

Individualised care programmes would have the advantage of involving the client and respecting their rights, while evaluating their functional abilities and dental status. Because the care plan would be negotiated with the client and care staff, the client's ability for independence could be encouraged, while the areas where assistance would be beneficial could be identified and appropriate action agreed. The likelihood of the plan succeeding on a daily basis might therefore be enhanced.

Who would be the most appropriate person to carry out clients' assessments? Involvement of members of the dental team would carry the advantage of raising the profile of oral health care within the home, and of encouraging dental experts to be considered as an essential part of the consultative and diagnostic process. If assessments were carried out by a dentist, other oral health problems could be diagnosed, explanation and discussion could take place if appropriate, and clients could be offered the option of a realistic level of professional dental care. Other dental team members (e.g. therapists, oral health educators, dental nurses with oral hygiene qualifications) could be used as a less expensive alternative, although the diagnostic screening element of the assessment would be diminished. Another possibility is that nursing home staff might be satisfactorily trained to monitor oral health and clients' ability to remove denture plaque and dental-plaque. However, the findings of Thai *et al.* (1997) suggest that nurses would identify disappointingly few problems. Nurse-assessment might be suitable as an initial measure, or even for periodic monitoring, so that there was less likelihood of a hiatus in oral health care after admission or after a significant change in general health status. However, it would be unwise if assessment by nursing home staff in isolation were used to justify the failure to arrange regular professional dental screening. A study to assess the effectiveness of the various options would be valuable.

Appendix 1

CLINICAL SCORING FORM

Clinical Examination of Clients

Name of resident _____ Nursing home ID No____Client ID No____

Missing values: score 9

1. Age	**2. Sex**	**3. Mobility**	
	1=female **2=male**	**1** Ambulant **2** Chairbound **3** Bedbound	

A	**CLIENTS WITH DENTURES**		
4	Do you clean your own dentures?	1=Yes - easily 2=Yes - with difficulty 3=No	☐
5	Do the staff clean your dentures?	1=Daily 2=Occasionally 3=Never	☐
B	**CLIENTS WITH NATURAL TEETH**		
6	Do you clean your own teeth?	1=Yes - easily 2=Yes - with difficulty 3=No	☐
7	Do the staff clean your teeth?	1=Daily 2=Occasionally 3=Never	☐
C	**ALL CLIENTS**		
8	When did you last see a dentist?	1=Less than 12 months 2=1-5 years 3=Over 5 years 4=Don't know	☐
9	Has anyone asked you if you would like a dental check-up since you came to this home?	1=Yes 2=No	☐
10	Are you having any dental problem at the moment?	1=Yes 2=No	☐

DENTURES

11. Dentures worn

0 No denture
1 Partial denture
2 Complete denture

Upper denture ☐
Lower denture ☐

12 Soft debris on dentures

0 Absent
1 Present

Upper denture ☐
Lower denture ☐

13 Calculus on denture

0 Absent
1 Present

Upper denture ☐
Lower denture ☐

14. Disclose dentures and score plaque

0 No plaque
1 Light plaque [1%-25% of area covered]
2 Moderate plaque[26% - 50% covered]
3 Heavy plaque [51% - 75% covered]
4 Very heavy plaque [76%-100%]
9 Section of denture absent

Upper R buccal		Upper L buccal	
7654	321	123	4567

Upper R fit surface		Upper L fit surface	
Posterior	Anterior	Anterior	Posterior

Lower R buccal		Lower L buccal	
7654	321	123	4567

Lower R fit surface		Lower L fit surface	
Posterior	Anterior	Anterior	Posterior

15. Denture-induced stomatitis

0 Absent
1 Pin-point erythema
2 Diffuse erythema
3 Inflammatory papillary hyperplasia

☐

NATURAL TEETH

16. Disclose the mouth with disclosing solution and rinse

17. Score plaque on natural teeth

0 No plaque present
1 Plaque covering less than one third of crown of tooth
2 Plaque covering at least one third but less than two thirds of crown
3 Plaque covering two thirds or more of crown of tooth
8 Restored surface / surface not recordable
9 Tooth absent

UPPER RIGHT **UPPER LEFT**

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
buc																	buc
ling																	ling

LOWER RIGHT **LOWER LEFT**

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
buc																	buc
ling																	ling

18. Score visible calculus

0 No calculus
1 Calculus
9 Tooth absent

UPPER RIGHT **UPPER LEFT**

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
buc																	buc
ling																	ling

LOWER RIGHT **LOWER LEFT**

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
buc																	buc
ling																	ling

19. Score marginal gingivitis

0 No inflammation
1 Marginal inflammation or slight swelling
2 Severe inflammation & swelling
9 Segment not dentate

UR Post	Upper ant	UL post

BUCCAL

LINGUAL

LR post	Lower ant	LL post

.....

20. ROOT CARIES

0 No caries
1 Caries present
9 Tooth absent

UPPER RIGHT **UPPER LEFT**

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
buc																	buc
ling																	ling

LOWER RIGHT **LOWER LEFT**

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
buc																	buc
ling																	ling

.....

19. MOBILE TEETH [>1mm mobility]

0 Not mobile
1 Mobile
9 Tooth absent

UPPER RIGHT **UPPER LEFT**

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

LOWER RIGHT **LOWER LEFT**

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

Appendix 2

CARERS' QUESTIONNAIRE

UNIVERSITY OF BRISTOL
Department of Oral and Dental Science

Survey of Oral Care for Nursing Home Clients

Please help us to improve dental health promotion services by filling in this questionnaire. Your answers will help in planning future dental support services for staff and clients in nursing homes

The nursing home where you work has been randomly selected to take part in the survey. The questionnaires are numbered solely for the purpose of comparing replies, not to identify you personally in any way.

Your replies are completely confidential.

PLEASE ANSWER EVERY QUESTION

PLEASE SEAL YOUR COMPLETED QUESTIONNAIRE IN THE ENCLOSED ENVELOPE AND RETURN TO MATRON READY FOR US TO COLLECT

Researcher: Dr Heather Frenkel
Bristol Dental Hospital and School, Lower Maudlin Street, Bristol BS1 2LY
Telephone (0117) 928 4361

CARING FOR CLIENTS WITH DENTURES

Do you use any denture cleaning products in this nursing home?

(Please tick one box ☑)

Yes ❑
No ❑
Don't know ❑

If yes, please write the name(s) of the denture cleaners in the space on the right

Please indicate whether you think the following statements are true or false.

Please tick one box ☑ in each row

1. Ideally, clients' dentures should be taken out at night	True ❑	False ❑	Don't know ❑
2. Denture cleaning solutions remove the dirt from dentures without you needing to brush as well	True ❑	False ❑	Don't know ❑
3. Soft food often sticks to dentures, but it does not make them uncomfortable to wear	True ❑	False ❑	Don't know ❑
4. Bacteria tend not to stick to the surfaces of dentures	True ❑	False ❑	Don't know ❑
5. Unclean dentures can cause mouth infections	True ❑	False ❑	Don't know ❑
6. For clients' comfort, dentures should be rinsed after every meal	True ❑	False ❑	Don't know ❑
7. Clients without any natural teeth only need a dental check-up when they have a problem	True ❑	False ❑	Don't know ❑
8. Clients usually notice discomfort if they have a gum infection underneath their dentures	True ❑	False ❑	Don't know ❑
9. A dirty denture may be unsightly, but it will not cause any disease in the mouth	True ❑	False ❑	Don't know ❑
10. Thorough brushing cleans dentures more effectively than soaking in a denture cleaner	True ❑	False ❑	Don't know ❑
11. Wearing a denture increases the number of bacteria in the mouth	True ❑	False ❑	Don't know ❑

CARING FOR CLIENTS WITH THEIR OWN TEETH

8. Please indicate whether you think the following statements are true or false.

Please tick one box ☑ in each row

12. A softer toothbrush is better than a hard one for cleaning clients' teeth	True ❑	False ❑	Don't know ❑
13. A large-headed toothbrush is less efficient at cleaning teeth than a small-headed toothbrush	True ❑	False ❑	Don't know ❑
14. Lack of calcium can put clients at risk from tooth decay	True ❑	False ❑	Don't know ❑
15. Old people's teeth are less prone to decay than younger people's teeth	True ❑	False ❑	Don't know ❑
16. Brushing clients' teeth will also improve the condition of their gums	True ❑	False ❑	Don't know ❑
17. If clients' have a lot of sugary food and drink, their teeth are more likely to decay	True ❑	False ❑	Don't know ❑
18. A mouth-swab is a good alternative to a toothbrush for cleaning clients' teeth	True ❑	False ❑	Don't know ❑
19. It is possible to catch certain infections from contact with a client's saliva	True ❑	False ❑	Don't know ❑
20. Bacteria in clients' mouths are one of the causes of dental decay	True ❑	False ❑	Don't know ❑
21. Clients with dry mouths will tend to get less decay	True ❑	False ❑	Don't know ❑
22. Even if the gums around the teeth are inflamed or bleeding, they do not usually cause any pain	True ❑	False ❑	Don't know ❑
23. For health and safety reasons, you should wear protective gloves when cleaning clients' teeth	True ❑	False ❑	Don't know ❑
24. Most clients with bad teeth will have inherited a tendency to get decay	True ❑	False ❑	Don't know ❑
25. Once gum disease has started it is almost impossible to halt	True ❑	False ❑	Don't know ❑
26. Older people can often get more decay than younger people	True ❑	False ❑	Don't know ❑

The following statements are based on what carers in other nursing homes have said about looking after clients who have their own [natural] teeth.

We are interested in your comments and opinions on these statements. Space is provided at the end of the question for you to write your own views

First, please indicate how strongly you agree or disagree with the statements by ticking the box that most closely reflects your own feelings.

Please tick one box ☑ in each row

	Strongly agree	Tend to agree	Tend to disagree	Strongly disagree	No opinion
1. I see it as my responsibility to keep my clients' natural teeth clean	☐	☐	☐	☐	☐
2. I feel more uncomfortable brushing inside a client's mouth than I do with most other kinds of personal care	☐	☐	☐	☐	☐
3. I believe I can help in preventing my clients' teeth from becoming decayed	☐	☐	☐	☐	☐
4. I think that only the dentist can prevent clients' teeth from decaying	☐	☐	☐	☐	☐
5. If clients' gums bleed, I feel I should probably stop brushing their teeth altogether	☐	☐	☐	☐	☐
6. Cleaning clients' natural teeth is a task I feel confident to carry out	☐	☐	☐	☐	☐
7. I believe I can play a useful part in preventing my clients from getting gum disease	☐	☐	☐	☐	☐
8. When I brush clients' natural teeth, I think I do it competently	☐	☐	☐	☐	☐
9 I think that the dentist is the only person who can help clients who have gum disease	☐	☐	☐	☐	☐
10. When a client's gums bleed as I brush, I think I should step up my brushing efforts	☐	☐	☐	☐	☐
11. Brushing teeth is a very personal thing that you should not be expected to do for somebody else	☐	☐	☐	☐	☐

	Strongly agree	Tend to agree	Tend to disagree	Strongly disagree	No opinion
12. In my opinion, it is better to wait until clients have a problem before asking the dentist to see them	☐	☐	☐	☐	☐
13. When I brush a client's teeth, I feel unsure if I am doing it right	☐	☐	☐	☐	☐

Please use the space below to write down your own comments and views about the statements you have just considered.

HOW YOU FEEL ABOUT YOUR OWN ORAL HEALTH

10. Please indicate how strongly you agree or disagree with the following statements.

Please tick one box ☑ in each row

	Strongly agree	Tend to agree	Tend to disagree	Strongly disagree	No opinion
14. I believe my own teeth should last me throughout my life	☐	☐	☐	☐	☐
15. I find there is very little I can do to prevent myself getting dental problems	☐	☐	☐	☐	☐

	Strongly agree	Tend to agree	Tend to disagree	Strongly disagree	No opinion
16. I feel that dentures are less trouble than looking after your own teeth	❑	❑	❑	❑	❑
17. If my gums bleed when I brush, I suppose it means I have been brushing too hard	❑	❑	❑	❑	❑
18. Up to now, I feel I have looked after my teeth well	❑	❑	❑	❑	❑
19. As you get older, I think you are bound to lose some of your teeth	❑	❑	❑	❑	❑
20. If I was too ill or disabled to clean my own teeth, I hope somebody would to do it for me	❑	❑	❑	❑	❑
21. I worry that I haven't been able to look after my teeth as well as I would have liked	❑	❑	❑	❑	❑
22. It is important to me to keep all of my own teeth	❑	❑	❑	❑	❑
23. I rely on the dentist to prevent me from getting dental problems	❑	❑	❑	❑	❑
24. If my gums bleed when I brush my teeth, I worry that I am not looking after them well enough	❑	❑	❑	❑	❑
25. It is my own responsibility to look after the health of my mouth	❑	❑	❑	❑	❑

If you have any other comments to add about your own experiences with dental health and dental treatment, we would be very interested to hear them. Please write in the space below.

BACKGROUND INFORMATION ABOUT YOURSELF

We would be grateful if you could provide the following personal details so that we can compare answers from all the people taking part in this survey:

Which is your age group? *Please tick one box* ☑

16-25 ☐
26-35 ☐
36-45 ☐
46-55 ☐
Over 55 ☐

Your sex?

Female ☐ Male ☐

How long *in total* have you been employed in nursing home work?

____years [If less than a year, write the number of months ____months]

How long have you worked in *this* nursing home?

Please tick one box ☑

Less than 6 months ☐
6-11 months ☐
1-2 years ☐
3 years and over ☐

Which shift do you *usually* work? *Please tick one box* ☑

All day ☐
Early day-shift ☐
Late day-shift ☐
Night shift ☐
Other (please specify) _____
_____

Are you registered with a dentist yourself? *Please tick one box* ☑

Yes ☐
No ☐
Other (please specify) _____
_____

Please indicate the statement that best describes your usual pattern of visiting the dentist. *Please tick one box only* ☑

Regular check-ups once a year or more ❑

Only when I think something needs doing, although I am not getting any pain ❑

Only when I am getting some discomfort ❑

Only when I am having severe pain ❑

Other (please specify) _____

_____

_____

Imagine you are a client living in a nursing home. Can you suggest any improvements in oral care that would you like to see? If possible, explain the reasons for your answer. (Use the space below for your reply)

PLEASE SEAL THIS COMPLETED QUESTIONNAIRE IN THE ENVELOPE PROVIDED AND RETURN IT TO MATRON READY FOR THE RESEARCHER TO COLLECT

Thank you very much for completing the questionnaire

Appendix 3

TEACHING AIDS

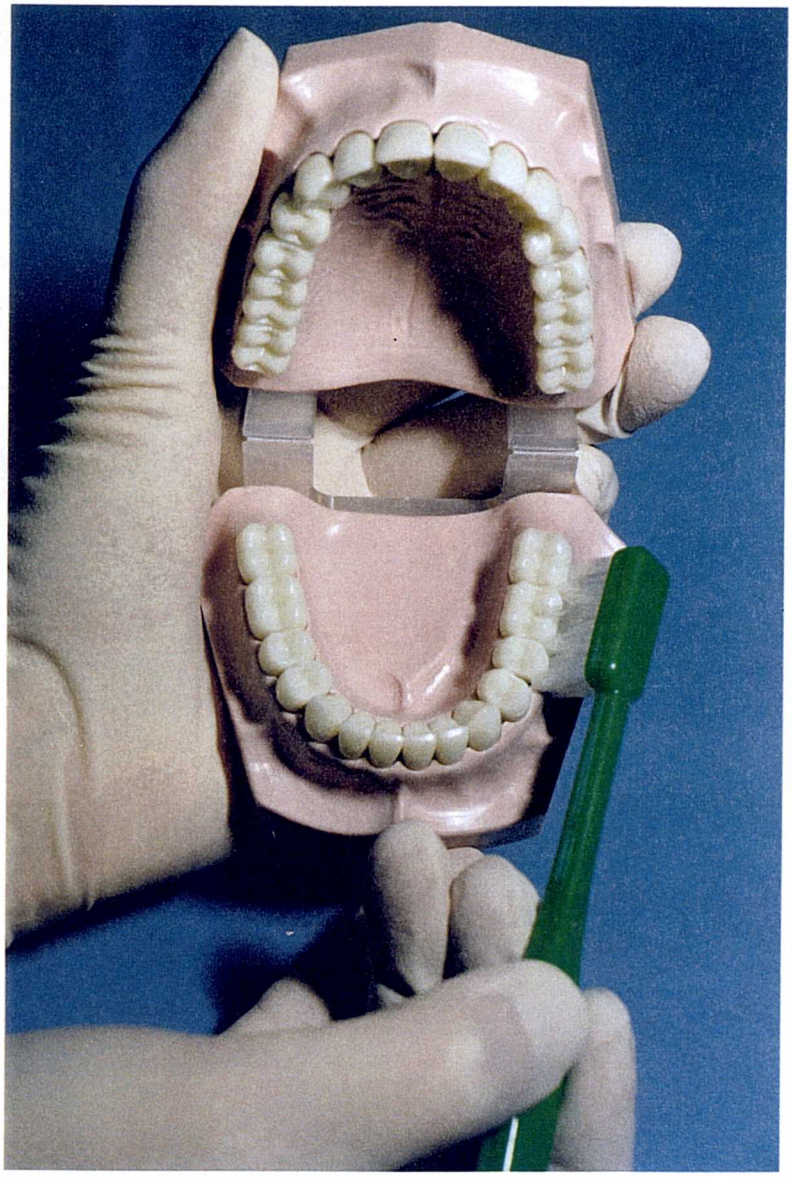


Figure 1:
Toothbrushing demonstration models

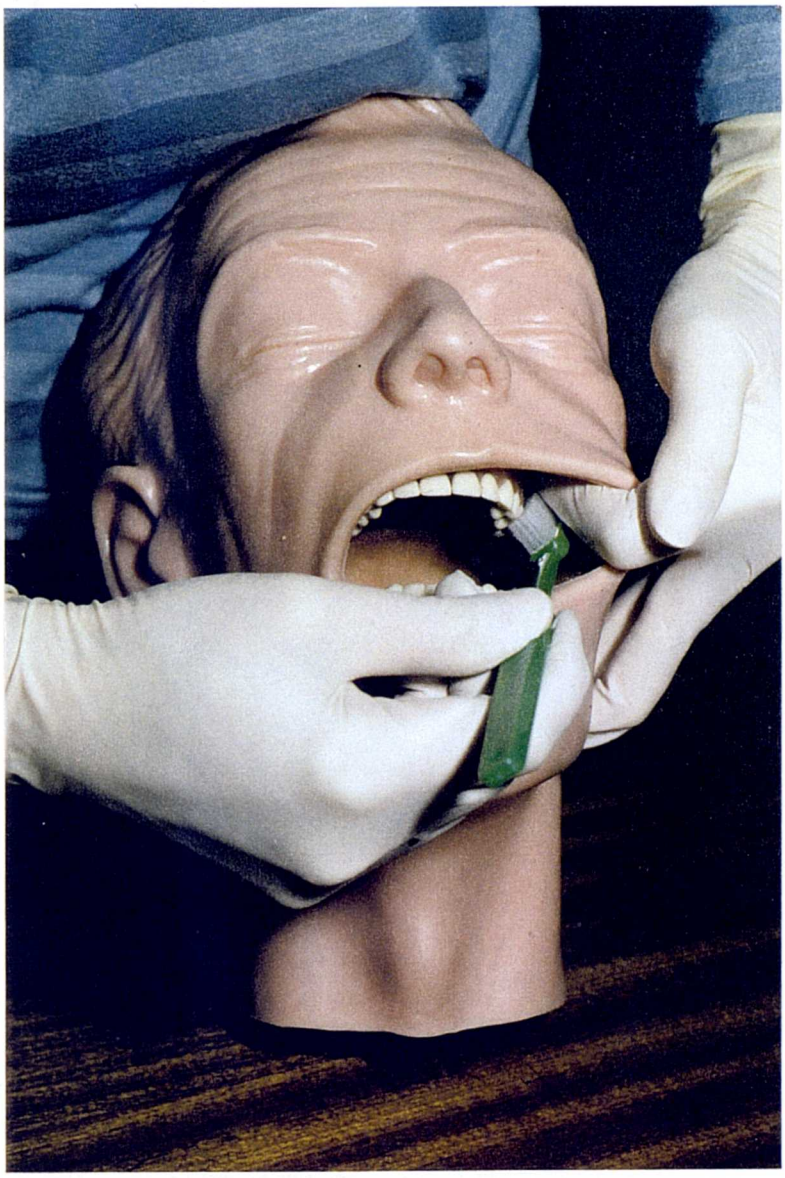


Figure 2:
Manikin head for carers' toothbrushing practice

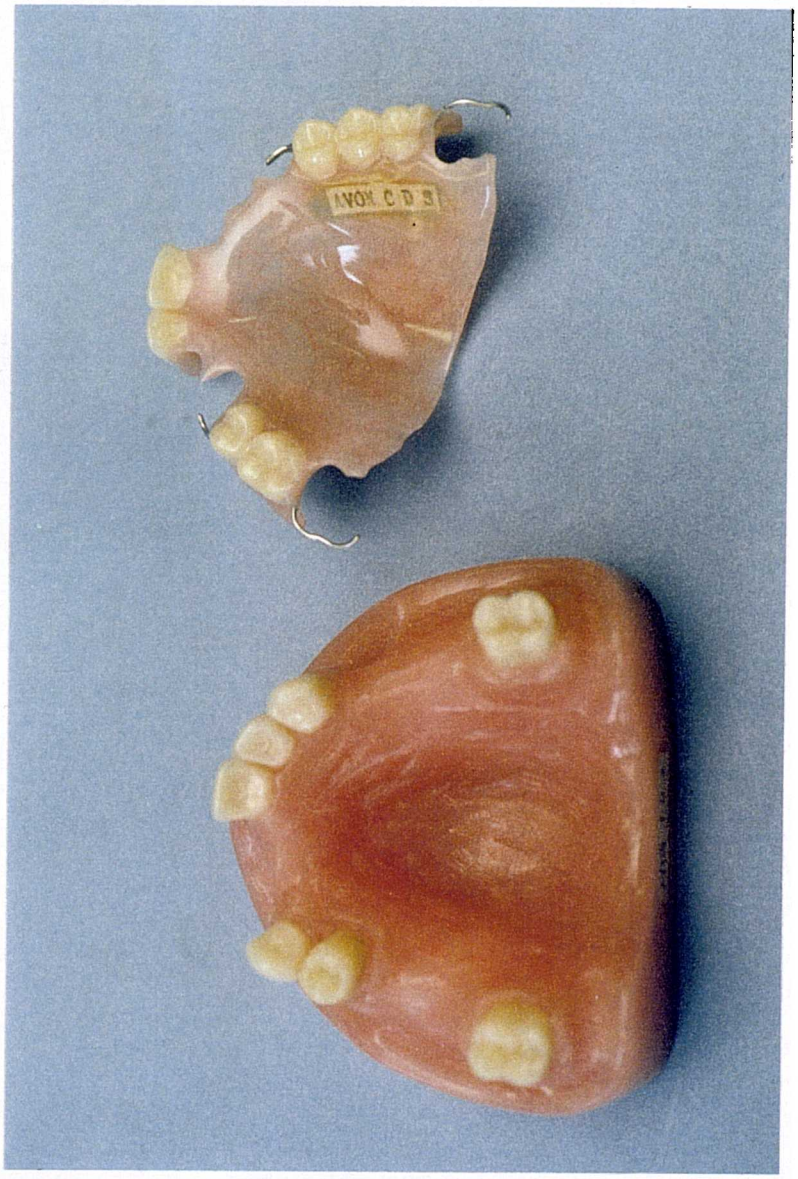


Figure 3:
Model for demonstration and practice of upper partial denture insertion
(Lower model and denture also used)

Appendix 4:

CARERS' ORAL HEALTH CARE BOOKLET

Caring for your clients' mouths

A guide for nursing home carers

Avon Community Dental Services
Oral Health Promotion Unit, Kingswood Health Centre
Alma Road, Bristol BS15 4EJ Tel [0117] 967 7191

What dental problems are clients likely to have?

Just like the rest of us, elderly people can suffer from problems with their teeth and gums. Many of them put up with uncomfortable mouths because they think that nothing can be done to help. In fact, dental disease is not an inevitable part of life. Much can be prevented with simple, regular daily care of teeth and dentures. With your help, the quality of your clients' lives can be greatly improved.

Why do dental diseases occur?

The cause of most dental problems is **plaque**. It affects people who wear dentures as well as those who have their own teeth.

- ***What is plaque?***

Plaque is a thin film of bacteria that builds up in the mouth each day. Plaque sticks firmly to natural teeth and dentures. At first, it is almost colourless, but gradually it thickens to form a soft whitish layer. It may look harmless, but it smells unpleasant and can cause infections and disease in the mouth.

- ***How does plaque affect the mouth?***

If you clean plaque off teeth and dentures thoroughly each day, it does not cause any problems. But if plaque builds up for more than 24 hours, the bacteria multiply and cause disease in both teeth and gums.

How does plaque affect people with dentures?

Wearing a denture increases the amount of plaque in the mouth. Plaque sticks very readily indeed to dentures, including the surface that rests against the gums.

If you do not brush dentures thoroughly every day, the plaque gets thicker and thicker, and the numbers of plaque bacteria reach a very high level. All the time the dentures are being worn, they hold massive numbers of bacteria against the gums. The bacteria make the gums inflamed. Often the whole area of gum under the denture becomes a bright, angry red colour.

This inflammation is a form of thrush. It is usually painless, so the client often does not notice that anything is wrong. However, thrush infection can spread to the throat or gastric tract, and the client's general health may suffer.

- ***What can I do to prevent this happening?***

You can help prevent thrush in denture wearers by removing all denture plaque at least once a day. The best way to do this is by **brushing.**

Use a small or medium-headed toothbrush with a little liquid soap or denture cream. Scrub thoroughly over all the surfaces of the denture. Rinse, then leave in plain water overnight.

If clients like you to use denture cleaners, respect their wishes. However, most denture soaking solutions do not remove all the plaque.

You still need to brush.

- ***Should I do anything more to keep dentures clean?***

Most people like to rinse their dentures after each meal. It is very uncomfortable when food gets under a denture - rather like having a piece of gravel in your shoe. When clients are not able to rinse their dentures themselves after meals, ask them if they would like you to do it for them. They will really appreciate your offer.

- ***Should I do anything to help clients who clean their own dentures?***

Some clients like to clean their own dentures because it makes them feel more independent. This is important for their self-esteem. So it is a good idea to let clients carry out their own cleaning routine

However, many elderly people suffer from poor eyesight or their fingers are no longer strong enough to clean dentures properly. So please try to brush the dentures again yourself to make sure they are clean. Be tactful about this if it is likely to upset the client!

- ***Should clients leave dentures out at night?***

Ideally, yes. Leaving dentures out at night rests the gums. This keeps gums healthier and less likely to develop infections.

However, some clients feel uncomfortable sleeping without dentures. In that case, make sure you brush the dentures thoroughly before bedtime, then soak them for 20 minutes in diluted Milton solution, and rinse them well after soaking. This special cleaning routine reduces the risk of mouth infections for night-time denture wearers.

How does plaque affect natural teeth?

Plaque bacteria combine with sugar from food and drinks to produce an acid that attacks the surface of natural teeth. If the acid-plaque is not thoroughly brushed off every day, it will gradually damage the surface of the teeth and cause decay.

While brushing alone will not prevent decay, using a fluoride toothpaste is a most effective measure in reducing decay. Brushing at least once a day with fluoride tooth paste is the most effective way of applying fluoride to the teeth.

- ***Are old people still likely to get decay?***

Older people are just as much at risk of getting decay as younger people. In fact, they are often **more** prone to decay, especially at the point where the gums meet the teeth. Many old people suffer from dry mouths. This makes the plaque thicker and the decay-making acid in the plaque more concentrated. Old people are also at risk because they are often too frail to brush their teeth properly to get rid of the plaque.

How does plaque affect gums?

Plaque collects mainly in the areas where the gums and the teeth meet. If the plaque is removed by brushing thoroughly at least once a day, the gums stay healthy. Without daily brushing, the plaque bacteria multiply and cause inflammation of the gums. This inflammation is known as **gingivitis**. Gingivitis is often painless, so clients may not be aware they have it.

- ***How can I tell if a client has gingivitis?***

First, you may notice a client has bad breath. This is often caused by plaque and inflamed gums. The longer plaque builds up, the worse the gingivitis and bad breath become.

Next, when you look at the mouth of a client with gingivitis, you will see their **gums are red and slightly puffy or shiny**. In contrast, healthy gums look pale pink with a matt surface.

Then, when you brush the client's teeth, you may notice the **gums bleeding**. This does **not** happen because you have been brushing too hard or because the client's general health is poor. It happens because the client's inflamed gums are more fragile when brushed.

- ***Can I do anything to halt gum disease?***

Yes, gingivitis will improve with very simple care. You just need to brush teeth and gums thoroughly at least once a day to remove plaque. At first, the gums will still bleed, but don't be put off. **The more you brush, the healthier the gums will become.**

After a week or two of thorough brushing, the bleeding should have stopped. The gums should look firmer and pinker. Then you can keep gingivitis at bay by continuing your daily routine of thorough brushing.

But if the gums do not improve, ask a dentist to see if the client needs some additional professional dental treatment.

- ***How do I brush clients' teeth?***

Many carers find they can't see clearly into a client's mouth. They are afraid of hurting their clients when brushing. Here are a few tips to help you.

1. Use a **small-headed toothbrush with soft or medium bristles**. A small brush is easier to move around the mouth to reach all the awkward places.
2. Use a **fluoride toothpaste** to strengthen teeth against decay. A smear of toothpaste is enough. A large amount can make too much froth.
3. Seat the client and stand slightly to one side - to the right if you are right handed, to the left if left handed.
4. If you are worried about using too much force, try using a 'pen-grip', rather than holding it in the palm of your hand.
5. With your free hand, gently pull back the client's cheek with your finger to give yourself a clear view into the mouth.
6. Place the toothbrush bristles against the teeth, near to the gums. Brush gently back and forth using **short scrubbing strokes**.

7. Gradually work your way all around the outside surfaces of all the teeth. Change your position as you work. You may find some areas are easier to reach if you stand in front of the client.
8. Then brush around the inside surfaces and the biting surfaces of the teeth.
9. Finally, let the client spit out into a bowl or washbasin. Then let them enjoy the sensation of a fresh, clean mouth.

- ***Are mouth swabs or sponge sticks any use for cleaning teeth?***

No. Swabs and sponge sticks just pack plaque and pieces of food between the teeth, causing worse problems for the client. There is nothing to beat a toothbrush for removing plaque!

- ***Should I wear protective gloves when I clean clients' teeth and dentures?***

Yes, it is advisable to wear gloves to reduce the risk of picking up infections from clients' mouths. You may have noticed that dentists now wear gloves when treating all patients. This is because some people may carry viruses in their blood or saliva that they can pass on to others through blood or saliva. The most common of these viruses are Hepatitis B, HIV and Herpes.

You will certainly come across saliva, and sometimes blood from bleeding gums. So wearing protective gloves will safeguard your own health.

You can see what a very important role you play in setting the standard for your clients' oral health.

The daily oral care you give is the main factor that influences the health and comfort of their mouths.

Without your thorough daily cleaning routine, no number of dentist's visits will keep your client's mouths healthy.

However, your clients still need to see a dentist regularly to treat the problems that need professional attention.

- ***How often should clients have a dental check?***

Ideally, every 6 months. Dental problems can develop quickly in elderly people. Many old people never tell you they are having a dental problem because they feel they have to expect it at their age. They worry about bothering the dentist, or failing to cope with the treatment.

In fact, most dental problems are easily solved. Dentists who work with elderly people avoid carrying out long courses of treatment. They try to make clients healthy and comfortable, while altering their teeth and dentures as little as possible. Very simple treatment can make a big improvement to the clients' comfort and well-being.

So it's a good idea to recommend a regular routine dental check-up for all your clients.

- ***Do clients with no natural teeth still need dental checks?***

Even people without natural teeth should have their mouths checked at least once a year. As well inspecting gums and dentures, the dentist can look for very early signs of cancer. Treated early, the chance of curing mouth cancer is excellent.

We hope that this leaflet has helped you understand how important a healthy mouth is for the general health and well-being of elderly people-

- and that it will help you provide the high standard of mouth and denture cleanliness that your clients deserve

REMEMBER

The day-to-day health of your clients' mouths depends on YOU.

Please help the dentists who treat your clients by following these simple guidelines

For clients with dentures

- Thoroughly remove all plaque once a day by **brushing** dentures
- Rinse dentures after each meal

For clients with natural teeth

- Thoroughly remove all plaque once a day by **brushing** clients' teeth and gums with fluoride toothpaste

For all clients

- Encourage all clients to have a regular dental check
  - every 6 months for clients with natural teeth
  - every 12 months for clients with no natural teeth

If you would like any more information or you are interested in receiving further oral health advice in your workplace, please contact
Oral Health Promotion Unit, Kingswood Health Centre
Alma Road, Bristol BS15 4EJ Tel [0117] 967 7191

Avon Community Dental Services

As well as Oral Health Promotion, Avon Community Dental Services also offer domiciliary treatment to homebound people who would not otherwise be able to obtain dental care. If you are unable to find a local dentist to visit the clients in your nursing home, please contact the address below for assistance:

Community Dental Office
Bristol Dental Hospital
Lower Maudlin Street
Bristol BS1 2LY

Tel [0117] 928 2262

Appendix 5:

PARTICIPANTS' CERTIFICATE AND PROGRAMME ASSESSMENT FORMS

United Bristol Healthcare (NHS) Trust

Avon Community Dental Services

Health Promotion Section, Kingswood Health Centre
Alma Road, Bristol BS15 4EJ Tel. (0117) 967 7191

This is to certify that

_ _ _ _ _ _ _ _ _ _ _ _

attended a
Health Promotion Course
on Oral Care for
Nursing Home Clients

_ _ _ _ _ _ _ _ _ _ _ _

Course Tutor *Date*

Avon Community Dental Services

HEALTH PROMOTION ASSESSMENT

Questionnaires help us assess and improve the quality of presentation of our Oral Health Promotion Programme.

Please complete all sections of the questionnaire in respect of the oral health promotion session you have just attended.

Please place your completed form in the box provided.

Was the time of the health promotion session convenient for you? Yes ❑ No ❑

If not, what time would have been more convenient for you? _____

Please place a tick in the box that most nearly represents your opinion:

Was the presenter well organised?	very well	❑ ❑ ❑ ❑	not at all
Did the presenter speak clearly enough?	yes	❑ ❑ ❑ ❑	no
Did the presenter make the material interesting?	very much so	❑ ❑ ❑ ❑	not at all
Did you understand the presenter's explanations of the material?	very well	❑ ❑ ❑ ❑	not at all
How well did the material fit your needs?	very well	❑ ❑ ❑ ❑	not at all
Was the material presented at a satisfactory pace for your needs?	too fast	❑ ❑ ❑ ❑	too slow
Did you enjoy the session?	very much	❑ ❑ ❑ ❑	not at all
Did you learn anything new?	learned a lot	❑ ❑ ❑ ❑	learned nothing
Will the information you received help you in caring for your clients?	very much so	❑ ❑ ❑ ❑	not at all

Oral Health Promotion in Nursing Homes
Presenter's Evaluation Sheet

Presenter..... **Date**.....

Nursing home..... **No. in group**.....

In general, how did you feel the session went?	very well	❑ ❑ ❑ ❑ ❑	not very well
Did you cover all the material you wanted to present?	all of it	❑ ❑ ❑ ❑ ❑	none of it
Did the participants appear interested in what you said?	all of them	❑ ❑ ❑ ❑ ❑	none of them
Did they contribute to the discussion?	all of them	❑ ❑ ❑ ❑ ❑	none of them
Did they take part in the practical section?	all of them	❑ ❑ ❑ ❑ ❑	none of them
Did they ask any questions?	yes, a lot	❑ ❑ ❑ ❑ ❑	none at all
Did they give you any feedback about the session?	yes, a lot	❑ ❑ ❑ ❑ ❑	none at all
Was feedback positive or negative?	positive	❑ ❑ ❑ ❑ ❑	negative
Did you feel the session had been worth while?	very much so	❑ ❑ ❑ ❑ ❑	not at all

Please add any further comments about the session in the space below & overleaf:

TIME SPENT ON THIS HEALTH PROMOTION SESSION

Presentation time - - - - - - - - - - - - - - - - -Travelling time - - - - - - - - - - - - - - - - -

Appendix 6

CLUSTER RANDOMISATION ANALYSIS: CALCULATION OF VISIT 2 & 3 MEANS, ADJUSTED FOR BASELINE IMBALANCE

Table 1: Within-homes regression slopes and adjusted means for the main outcome variables, comparing baseline with visit 2.

Adjusted mean difference I-C = Intervention group adjusted mean difference minus control group adjusted mean difference (negative value indicates a benefit to the intervention group)

Outcome measure	Within-homes regression slope	Visit 2 means adjusted for baseline imbalance		Adjusted mean difference (I-C)	SE of adjusted mean	
		C	I		C	I
Denture plaque						
All surfaces	0.527	2.82	1.67	-1.15	0.048	0.049
Buccal surfaces	0.545	2.64	1.62	-1.02	0.054	0.048
Mucosal surfaces	0.466	2.99	1.73	-1.27	0.054	0.056
Dental plaque						
All surfaces	0.498	2.09	1.67	-0.41	0.059	0.057
Buccal surfaces	0.471	2.23	2.00	-0.24	0.064	0.090
Mucosal surfaces	0.554	1.96	1.35	-0.61	0.075	0.063
Gingivitis						
All segments	0.425	1.30	1.12	-0.17	0.050	0.057
Anterior segments	0.460	1.38	1.16	-0.22	0.060	0.064
Posterior segments	0.493	1.24	1.11	-0.13	0.055	0.050
Buccal segments	0.494	1.43	1.30	-0.12	0.057	0.054
Lingual segments	0.346	1.16	0.94	-0.23	0.056	0.073
Calculus						
All surfaces	0.589	0.34	0.31	-0.032	0.026	0.036
Buccal surfaces	0.493	0.40	0.31	-0.083	0.033	0.042
Lingual surfaces	0.645	0.28	0.28	-0.007	0.028	0.036
Cervical/root caries						
All surfaces	0.999	0.21	0.23	+0.021	0.020	0.027
Buccal surfaces	0.949	0.25	0.28	+0.031	0.020	0.029
Mucosal surfaces	0.913	0.18	0.16	-0.021	0.026	0.016
Tooth mobility						
	0.557	0.16	0.09	-0.067	0.032	0.027

Table 2: Within-homes regression slopes and adjusted means for the main outcome variables, comparing baseline with visit 3.

Adjusted mean difference I-C = Intervention group adjusted mean difference minus control group adjusted mean difference (negative value indicates a benefit to the intervention group)

Outcome measure	Within-homes regression slope	Visit 3 means adjusted for baseline imbalance		Adjusted mean difference (I-C)	SE of adjusted mean	
		C	I		C	I
Denture plaque						
All surfaces	0.390	3.08	1.62	-1.47	0.061	0.068
Buccal surfaces	0.399	2.90	1.56	-1.35	0.066	0.068
Mucosal surfaces	0.337	3.26	1.68	-1.58	0.065	0.076
Dental plaque						
All surfaces	0.473	2.19	1.86	-0.34	0.066	0.072
Buccal surfaces	0.461	2.44	2.24	-0.20	0.069	0.094
Mucosal surfaces	0.436	1.96	1.48	-0.48	0.088	0.075
Gingivitis						
All segments	0.410	1.36	1.08	-0.28	0.044	0.052
Anterior segments	0.465	1.43	1.16	-0.27	0.053	0.056
Posterior segments	0.392	1.33	1.05	-0.27	0.059	0.056
Buccal segments	0.455	1.43	1.17	-0.27	0.050	0.055
Lingual segments	0.342	1.29	0.99	-0.30	0.055	0.060
Calculus						
All surfaces	0.655	0.34	0.35	+0.008	0.030	0.022
Buccal surfaces	0.610	0.38	0.37	-0.006	0.039	0.029
Lingual surfaces	0.612	0.31	0.33	+0.024	0.034	0.025
Cervical/root caries						
All surfaces	1.009	0.30	0.28	-0.024	0.022	0.023
Buccal surfaces	0.953	0.36	0.32	-0.034	0.024	0.024
Mucosal surfaces	0.904	0.25	0.22	-0.031	0.030	0.031
Tooth mobility						
	0.671	0.21	0.13	-0.072	0.032	0.030

REFERENCES

References

Aaronson, W.E., Zinn, J.S. and Rosko, M.D. (1994) Do for-profit and not-for-profit nursing homes behave differently? *The Gerontologist* **34**: 775-786.

Abdellatif, H.M. and Burt, B.A. (1987) An epidemiological investigation into the relative importance of age and oral hygiene status as determinants of periodontitis. *Journal of Dental Research* **66**: 13-18.

Adams, R. (1996) Qualified nurses lack adequate knowledge related to oral health, resulting in inadequate oral care of patients on medical wards. *Journal of Advanced Nursing* **24**: 552-560.

Addy, M., Griffiths, G., Dummer, P., Kingdom, A. and Shaw, W.C. (1987) The distribution of plaque and gingivitis and the influence of tooth brushing hand in a group of South Wales 11-12 year-old children. *Journal of Clinical Periodontology* **14**: 564-572.

Addy, M. and Bates, J.F. (1979) Plaque accumulation following the wearing of different types of removable partial dentures. *Journal of Oral Rehabilitation* **6**: 111-117.

Ainamo, A. and Österberg, T. (1992) Changing demographic and oral disease patterns and treatment needs in the Scandinavian populations of old people. *International Dental Journal* **42**: 311-322.

Albino, J.E. (1983) Psychological aspects of oral conditions and treatments. *Clinical Preventive Dentistry* **5**: 21-28.

Alderman, C. (1988) Oral hygiene. *Nursing Standard* **2**: 24

Alexander, A.G. (1971) A study of the distribution of supra and subgingival calculus, bacterial plaque and gingival inflammation in the mouths of 400 individuals. *Journal of Periodontology* **42**: 21-28.

Altman, D.G. (1991) *Practical statistics for medical research.* pp. 38-44. London: Chapman and Hall.

Ambjørnsen, E. (1986) Remaining teeth, periodontal condition, oral hygiene and tooth cleaning habits in dentate old-age subjects. *Journal of Clinical Periodontology* **13**: 583-589.

Ambjørnsen, E. and Rise, J. (1985) The effect of verbal information and demonstration on denture hygiene in elderly people. *Acta Odontologica Scandinavia* **43**: 19-24.

Angelillo, I.F., Sagliocco, G., Hendricks, S.J.H. and Villari, P. (1990) Tooth loss and dental caries in institutionalised elderly in Italy. *Community Dentistry and Oral Epidemiology* **18**: 216-218.

Arendorf, T. and Walker, D.M. (1979) Oral candidal populations in health and disease. *British Dental Journal* **147**: 267-272.

Arendorf, T.M. and Walker, D.M. (1987) Denture stomatitis: a review. *Journal of Oral Rehabilitation* **14**: 217-227.

Arvidson-Bufano, U.B., Blank, L.W. and Yellowitz, J.A. (1996) Nurses' oral health assessments of nursing home residents pre- and post-training: a pilot study. *Special Care in Dentistry* **16**: 58-63.

Augsburger, R.H. and Elahi, J.M. (1982) Evaluation of seven proprietary denture cleansers. *Journal of Prosthetic Dentistry* **47**: 356-359.

Axelsson, P., Lindhe, J. and Nyström, B. (1991) On the prevention of caries and periodontal disease. *Journal of Clinical Periodontology* **18**: 182-189.

Banaszak-Holl, J. and Hines, M.A. (1996) Factors associated with nursing home staff turnover. *The Gerontologist* **36**: 512-517.

Banting, D.W., Ellen, R.P. and Fillery, E.D. (1980) Prevalence of root surface caries among institutionalised older persons. *Community Dentistry and Oral Epidemiology* **8**: 84-88.

Barnes, G.P., Parker, W.A., Lyon, T.C. and Fultz, R.P. (1986) Indices used to evaluate signs, symptoms and etiologic factors associated with diseases of the periodontium. *Journal of Periodontology* **56**: 643-651.

Barnett, J. (1991) A reassessment of oral healthcare. *Professional Nurse* **6**: 703-708.

Baum, B.J. (1996) Changes in salivary glands and salivary secretion with aging. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of geriatric dentistry.* 2nd edition. pp. 117-126. Copenhagen: Munksgaard.

Bauman, R. (1980) Survey of dentists' attitudes regarding instructions for home care for patients who wear dentures. *Journal of the American Dental Association* **100**: 206-208.

Beal, J.F. (1983) Social factors and preventive dentistry. In: Murray, J.J. (Ed.) *The prevention of dental diseases.* pp. 313-342. Oxford: Oxford University Press.

Beck, J.D. (1984) The epidemiology of dental diseases in the elderly. *Gerodontology* **3**: 5-15.

Beck, J.D., Garcia, R., Heiss, G., Vokonas, P.S. and Offenbacher, S. (1996) Periodontal disease and cardiovascular disease. *Journal of Periodontology* **67**: 1123-1137.

Berkey, D.B., Call, R.L. and Loupe, M.J. (1985) Oral health perceptions and self-esteem in non-institutionalised older adults. *Gerodontics* **1**: 213-216.

Berkey, D.B. (1988) Clinical decision-making for the geriatric dental patient. *Gerodontics* **4**: 321-326.

Berkey, D.B., Call, R.L., Gordon, S.R. and Berkey, K.G. (1988) Barriers influencing dental care in long-term care facilities. *Gerodontics* **4**: 315-319.

Blaikie, D.C. (1979) Cultural barriers to preventive dentistry. *Australian Dental Journal* **24**: 398-401.

Blair, Y., Bagg, J., MacFarlane, T.W. and Chestnutt, I. (1995) Microbiological assessment of denture hygiene among patients in long-stay and day-care community places. *Community Dentistry and Oral Epidemiology* **23**: 100-103.

Blaney, G.M. (1986) Mouth care - basic and essential. *Geriatric Nursing* **7**: 242-243.

Blinkhorn, A.S. (1981) Dental Health Education. In: Slack, G.L. and Burt, B.A. (Eds.) *Dental Public Health.* 2nd edition. pp. 270-285. Bristol: John Wright & Sons.

Blinkhorn, A.S., Leathar, D.S. and Kay, E.J. (1989) An assessment of the value of quantitative and qualitative data collection techniques. *Community Dental Health* **6**: 147-151.

Blinkhorn, A.S. (1993) Evaluation and planning of oral health promotion programmes. In: Schou, L. and Blinkhorn, A.S. (Eds.) *Oral health promotion.* pp. 249-267. Oxford: Oxford Medical Publications.

Blinkhorn, A.S. (1998) Dental health education: what lessons have we ignored? *British Dental Journal* **184**: 58-59.

Block, P.L. (1976) Dental health in hospitalised patients. *American Journal of Nursing* **76**: 1162-1164.

Booth, H. and Leverett, D.H. (1976) Dental health and dental care in nursing homes in Monroe County, New York. *New York State Dental Journal* **42**: 410-414.

Booth, T., Bilson, A. and Fowell, I. (1990) Staff attitudes and caring practices in homes for the elderly. *British Journal of Social Work* **20**: 117-131.

Bowers, B. and Becker, M. (1992) Nurse's aides in nursing homes: the relationship between organisation and quality. *The Gerontologist* **32**: 360-366.

Boyd, M.F. (1920) *Practical Preventive Medicine.* London: W.B.Saunders and Co.

Boyd, R.V. (1981) What is a 'social problem' in geriatrics? In: Arie, T. (Ed.) *Health care of the elderly.* pp. 143-157. Beckenham: Croom Helm.

Breen, V.W. (1989) Education with activity: a health promotion program in a nursing home. *Occupational Therapy in Health Care* **6**: 101-111.

British Medical Association (1993) *Medical Ethics Today.* pp 195-229. London: BMJ Publishing Group.

Brody, E.M. and Kleban, M.H. (1981) Physical and mental health symptoms of older people: who do they tell? *Journal of the American Geriatrics Society* **29**: 442-449.

Brown, L.F. (1994) Research in dental health education and health promotion: a review of the literature. *Health Education Quarterly* **21**: 83-102.

Budtz-Jørgensen, E. (1978) Clinical aspects of Candida infection in denture wearers. *Journal of the American Dental Association* **96**: 474-479.

Budtz-Jørgensen, E., Mojon, P., Rentsch, A., Roehrich, N., von der Muehll, D. and Baehni, P. (1996) Caries prevalence and associated predisposing conditions in recently hospitalized elderly persons. *Acta Odontologica Scandinavia* **54**: 251-256.

Budtz-Jørgensen, E. and Löe, H. (1972) Chlorhexidine as a denture disinfectant in the treatment of denture stomatitis. *Scandinavian Journal of Dental Research* **80**: 457-464.

Burgio, L.D. and Burgio, K.L. (1990) Institutional staff training and management: a review of the literature and a model for geriatric long-term-care facilities. *International Journal of Aging and Human Development* **30**: 287-302.

Burt, B.A. (1978) Influences for change in the dental health status of populations: an historical perspective. *Journal of Public Health Dentistry* **38**: 272-288.

Burt, B.A. (1994) Periodontitis and aging: reviewing recent evidence. *Journal of the American Dental Association* **125**: 273-279.

Cardash, H.S., Helft, M., Shani, A. and Marshak, B. (1989) The prevalence of *Candida albicans* in denture wearers in an Israeli geriatric hospital. *Gerodontology* **8**: 101-107.

Castle, N.G. and Banaszak-Holl, J. (1997) Top management team characteristics and innovation in nursing homes. *The Gerontologist* **37**: 572-580.

Central Statistical Office. (1993) Annual abstract of statistics 1993. pp. 3-42. London: HMSO.

Challis, D., Darton, R., Johnson, L., Stone, M. and Traske, K. (1991) An evaluation of an alternative to long-stay hospital care for frail elderly patients. *Age and Ageing* **20**: 236-244.

Chalmers, J.M., Levy, S.M. and Kambhu, P.P. (1994) Attitudes of nurses' aides concerning oral health. *Journal of Dental Research* **73**: 336 (Abstract)

Chalmers, J.M., Levy, S.M., Buckwalter, K.C., Ettinger, R.L. and Kambhu, P.P. (1996) Factors influencing nurses' aides provision of oral care for nursing facility residents. *Special Care in Dentistry* **16**: 71-79.

Christensen, J. (1988) Domiciliary care for the elderly patient. *Dental Update* **15**: 284-290.

Christensen, J. (1992) Training for preventive oral care in institutions - a Danish model. *International Dental Journal* **42**: 393-397.

Ciancio, S.G. (1996) Medications as risk factors for periodontal disease. *Journal of Periodontology* **67**: 1055-1059.

Collis, J.J. and Stafford, G.D. (1994) A survey of denture hygiene patients attending Cardiff Dental Hospital. *European Journal of Prosthodontics and Restorative Dentistry* **3**: 67-71.

Coni, N., Davison, W. and Webster, S. (1993) *Lecture notes on geriatrics.* 4th edition. pp 32-39, 176, 207-208. Oxford: Blackwell Scientific Publications.

Connor, J.N.E., Schoenfeld, C.M. and Taylor, R.L. (1977) An evaluation of an enzyme denture cleanser. *Journal of Prosthetic Dentistry* **37**: 147-157.

Cushing, A.M., Sheiham, A. and Maizels, J. (1986) Developing socio-dental indicators - the social impact of dental disease. *Community Dental Health* **3**: 3-17.

Davies, K.W. and Whittle, J.G. (1990) Dental health education: training of homecarers of mentally handicapped adults. *Community Dental Health* **7**: 193-197.

Dawson, N. (1995) Questionnaire design and construction. Unpublished course notes. University of Bristol, Department of Education.

de Baat, C., Bruins, H.H., van Rossum, G.M.J.M. and Kalk, W. (1993) Oral health care for nursing home residents in the Netherlands: a national survey. *Community Dentistry and Oral Epidemiology* **21**: 240-242.

Dental Practice Board (1997) Registrations: General Dental Service Quarterly Statistics. Eastbourne: Dental Data Services.

DePaola, L.G., Minah, G.E. and Elias, S.A. (1984) Growth of potential pathogens in denture-soaking solution of myelosuppressed cancer patients. *Journal of Prosthetic Dentistry* **51**: 554-558.

DeStefano, F., Anda, R.F., Kahn, H.S., Williamson, D.F. and Russell, C.M. (1993) Dental disease and risk of coronary heart disease and mortality. *British Medical Journal* **306**: 688-691.

DeWalt, E.M. (1975) Effect of timed hygienic measures on oral mucosa in a group of elderly subjects. *Nursing Research* **24**: 104-108.

Dilley, C. (1990) Continuing education in private nursing homes. *Nursing Times* **86**: 52

Diu, S. (1992) Better oral health for older people. *Gerodontic Study Group Newsletter No. 3*: 7-8.

Diu, S. and Gelbier, S. (1987) Dental awareness and attitudes of general medical practitioners. *Community Dental Health* **4**: 437-444.

Diu, S. and Gelbier, S. (1989) Oral health screening of elderly people attending a community care centre. *Community Dentistry and Oral Epidemiology* **17**: 212-214.

Dolinsky, E.H. and Dolinsky, H.B. (1984) Infantilisation of elderly patients by health care providers. *Special Care in Dentistry* **4**: 150-153.

Donner, A., Birkett, N. and Buck, C. (1981) Randomization by cluster: sample size requirements and analysis. *American Journal of Epidemiology* **114**: 906-915.

Drummond, J.R., Newton, J.P. and Yemm, R. (1988) Dentistry for the elderly: a review and an assessment of the future. *Journal of Dentistry* **16**: 47-54.

Eadie, D.R. and Schou, L. (1992) An exploratory study of barriers to promoting oral hygiene through carers of elderly people. *Community Dental Health* **9**: 343-348.

Ebersole, P. and Hess, P. (1990) Maintenance needs - neglected areas: teeth, feet and integument. In: Ebersole, P. And Hess, P. *Towards healthy aging: human needs and nursing response.* pp. 200-207. St. Louis, Missouri: C.V.Mosby.

Ekelund, R. (1988) Effectiveness of tooth- and denture-brushing in the disabled elderly in municipal old people's homes in Finland. *Gerodontics* **4**: 63-65.

Ekelund, R. (1989) National survey of oral health care in Finnish private old people's homes. *Community Dentistry and Oral Epidemiology* **17**: 158-161.

Ekelund, R. (1991) National survey of oral health care in Finnish municipal old people's homes. *Community Dentistry and Oral Epidemiology* **19**: 169-172.

Empey, G., Kiyak, H.A. and Milgrom, P. (1983) Oral health in nursing homes. *Special Care in Dentistry* **3**: 65-67.

Ernst and Whinney (1986) Survey of private and voluntary residential and nursing homes for the DHSS. London: Ernst and Whinney.

Ettinger, R.L. (1987) Oral disease and its effect on the quality of life. *Gerodontics* **3**: 103-106.

Ettinger, R.L. (1992) Attitudes and values concerning oral health and utilization of services among the elderly. *International Dental Journal* **42**: 373-384.

Ettinger, R.L. (1996) Oral health care programs for homebound people, nursing home residents and elderly inpatients. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of geriatric dentistry.* 2nd edition. pp. 536-559. Copenhagen: Munksgaard.

Ettinger, R.L. (1997) The unique oral health needs of an aging population. *Dental Clinics of North America* **41**: 633-649.

Ettinger, R.L. and Manderson, R.D. (1975) Dental care of the elderly. *Nursing Times* **71**: 1003-1006.

Ewles, L. and Simnett, I. (1995) Planning and evaluating. In: Ewles, L. and Simnett, I. *Promoting Health.* 3rd edition. pp. 92-115. London: Scutari Press.

Farrell, J.H. (1956) The effect of mastication on the digestion of food. *British Dental Journal* **100**: 149-155.

Felder, R., James, K., Brown, C., Lemon, S. and Reveal, M. (1994a) Dexterity testing as a predictor of oral care ability. *Journal of the American Geriatrics Society* **42**: 1081-1086.

Felder, R., Reveal, M., Lemon, S. and Brown, C. (1994b) Testing toothbrush ability of elderly patients. *Special Care in Dentistry* **14**: 153-157.

Finch, H. (1988) Barriers to the receipt of dental care. *British Dental Journal* **164**: 195-196.

Fishman, S.K. (1989) Health professionals' attitudes toward older people. *Dental Clinics of North America* **33**: 7-10.

Fiske, J. and Lloyd, H.A. (1992) Dental needs of residents and carers in elderly people's homes and carers' attitudes to oral health. *European Journal of Prosthodontics and Restorative Dentistry.* **1**: 91-95.

Fox, P.C., van der Ven, P.F., Sonies, B.C., Weiffenbach, J.M. and Baum, B.J. (1985) Xerostomia: evaluation of a symptom with increasing significance. *Journal of the American Dental Association* **110**: 519-525.

Fraser, E., Bryce, C., Crosswaite, C., McCann, K. and Platt, S. (1995) Evaluating health promotion: doing it by numbers. *Health Education Journal* **54**: 214-225.

Freeman, R. and Linden, G. (1995) Health directed and health related dimensions of oral health behaviours of periodontal referrals. *Community Dental Health* **12**: 48-51.

Frenkel, H. and Harrison, A. (1995) Oral care attitudes and practices of staff caring for dependent clients resident in nursing homes. *Journal of Dental Research* **74**: 831(Abstract)

Galan, D. and Lynch, E. (1993) Epidemiology of root caries. *Gerodontology* **10**: 59-71.

Galan, D. and Lynch, E. (1994) Prevention of root caries in older adults. *Journal of the Canadian Dental Association* **60**: 422-433.

Gannon, E.P. and Kadezabek, E. (1980) Giving your patients meticulous mouth care. *Nursing* **10**: 14-19.

Geissler, P. and McCord, F. (1986) Dental care for the elderly. *Nursing Times* **82**: 53-54.

Giddon, D.B. (1964) Psychological aspects of geriatric patient management. *Journal of Dental Education* **29**: 286-292.

Gift, H.C. (1988) Issues of aging and oral health promotion. *Gerodontics* **4**: 194-206.

Gilbert, G.H. (1989) 'Ageism' in dental care delivery. *Journal of the American Dental Association* **118**: 545-548.

Glassman, P., Miller, C., Wozniak, T. and Jones, C. (1994) A preventive dentistry training program for caretakers of persons with disabilities residing in community residential facilities. *Special Care in Dentistry* **14**: 137-143.

Grau, L., Chandler, B. and Saunders, C. (1995) Nursing home residents' perceptions of the quality of their care. *Journal of Psychosocial Nursing* **33**: 34-41.

Greene, J.C. and Vermillion, J.R. (1964) The simplified oral hygiene index. *Journal of the American Dental Association* **68**: 25-31.

Hallett, N. (1984) Mouthcare. *Nursing Mirror* **159**: 31-33.

Hardy, D.L., Brangan, P.P., Darby, M.L., Leinbach, R.M. and Welliver, M.R. (1995) Self-report of oral health services provided by nurses' aides in nursing homes. *Journal of Dental Hygiene.* **69**: 75-82.

Harris, M.D. (1980) Tools for mouth care. *Nursing Times* **76**: 340-342.

Harrison, A. (1987) The mouth trap. *Nursing Times* **83**: 24-29.

Heiselman, T. and Noelker, L.S. (1991) Enhancing mutual respect among nursing assistants, residents and residents' families. *The Gerontologist* **31**: 552-555.

Henry, R.G. (1995) Functionally dependent veterans: issues related to providing and improving their oral health care. *Medical Care* **33** (11, Supplement): NS143-NS163.

Herriman, G., Kerschbaum, W. (1990) Oral hygiene care and education needs on long-term care facilities in Michigan. *Journal of Dental Hygiene* **74**: 196-198.

Hickey, T. (1988) Changing health perceptions of older patients and their implications for dentistry. *Gerodontics* **4**: 212-216.

Hoad-Reddick, G., Grant, A.A. and Griffiths, C.S. (1990) Investigation into the cleanliness of dentures in an elderly population. *Journal of Prosthetic Dentistry* **64**: 48-52.

Hoad-Reddick, G. (1991) A study to determine oral health needs of institutionalised elderly patients by non-dental health care workers. *Community Dentistry and Oral Epidemiology* **19**: 233-236.

Hoad-Reddick, G. (1992) Assessment of elderly people on entry to residential homes and continuing care arrangements. *Journal of Dentistry.* **20**: 199-201.

Hoad-Reddick, G. and Heath, J.R. (1993) The carer's perspective: results of a survey of attitudes to dental care in 250 residential homes in Manchester. *Journal of Oral Rehabilitation* **20**: 571-576.

Hoad-Reddick, G. and Heath, J.R. (1995) Identification of elderly in particular need: results of a survey undertaken in residential homes in the Manchester area. *Journal of Dentistry* **23**: 273-279.

Holm-Pedersen, P. (1996) Pathology and treatment of periodontal diseases in the aging individual. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of geriatric dentistry.* 2nd edition. pp. 388-405. Copenhagen: Munksgaard.

Holm-Pedersen, P., Agerbaek, N. and Theilade, E. (1975) Experimental gingivitis in young and elderly individuals. *Journal of Clinical Periodontology* **2**: 14-24.

Holm-Pedersen, P., Neely, A.N. and Katz, R.V. (1991) Periodontal disease in an institutionalised elderly population. *Journal of Dental Research* **70**: 415(Abstract)

Howarth, H. (1977) Mouth care procedures for the very ill. *Nursing Times* **73**: 354-355.

Hoyen-Chung, D.J. (1989) Oral hygiene training programmes in long-stay hospitals. *British Dental Journal* **167**: 178-179.

Hughes, D. (1981) Role stress reported by directors of nurses in skilled nursing homes. In: Archer, L. (Ed.) *Care of the aging.* pp. 75-91. Edinburgh: Churchill Livingstone.

Isaacs, B., Gunn, J., McKechan, A., McMillan, I. and Neville, Y. (1971) The concept of pre-death. *The Lancet* (May 29): 1115-1118.

Jeganathan, S., Payne, J.A. and Thean, H.P.Y. (1997) Denture stomatitis in an elderly Asian population. *Journal of Oral Rehabilitation* **24**: 468-472.

Jenkins, A. and Braithwaite, J. (1993) Profits, pressure and corporate lawbreaking. *Crime, Law and Social Change* **20**: 221-232.

Jenkins, S., Addy, M. and Newcombe, R. (1993) The effects of a chlorhexidine toothpaste on the development of plaque, gingivitis and tooth staining. *Journal of Clinical Periodontology* **20**: 59-62.

Johnson, B.D., Mulligan, K., Kiyak, H.A. and Marder, M. (1989) Aging or disease? Periodontal changes and treatment considerations in the older dental patient. *Gerodontology* **8**: 109-117.

Jokovic, A. and Locker, D. (1997) Dissatisfaction with oral health status in an older adult population. *Journal of Public Health Dentistry* **57**: 40-47.

Jokstad, A., Ambjørnsen, E. and Eide, K.E. (1996) Oral health in institutionalised elderly people in 1993 compared with in 1980. *Acta Odontologica Scandinavia* **54**: 303-308.

Jones, J.A., Fulmer, T. and Wetle, T. (1988) Oral health content in nursing school curricula. *Gerontology and Geriatrics Education* **8**: 95-101.

Jones, J.A., Lavallee, N., Alman, J., Sinclair, C. and Garcia, R.I. (1993) Caries incidence in patients with dementia. *Gerodontology* **10**: 76-82.

Jorge, J.Jr., Almeida, O.P. de., Bozzo, L., Scully, C. and Graner, E. (1991) Oral mucosal health and disease in institutionalised elderly in Brazil. *Community Dentistry and Oral Epidemiology* **19**: 173-175.

Joshi, A., Douglass, C.W., Jette, A., Feldman, H. (1994) The distribution of root caries in community-dwelling elders in New England. *Journal of Public Health Dentistry* **54**: (1):15-23.

Kahana, E.F. and Kiyak, H.A. (1984) Attitudes and behavior of staff in facilities for the aged. *Research on Aging* **6**: 395-416.

Kambhu, P.P. and Levy, S.M. (1993) Oral hygiene care levels in Iowa intermediate care facilities. *Special Care in Dentistry* **13**: 209-214.

Katz, R.V. (1980) Assessing root caries in populations: the evolution of the root caries index. *Journal of Public Health Dentistry* **40**: 7-15.

Katz, R.V., Hazen, S.P., Chilton, N.W. and Mumma, R.D.J. (1982) Prevalence and intraoral distribution of root caries in an adult population. *Caries Research* **16**: 265-271.

Katz, R.V., Neely, A.N. and Morse, D.E. (1996) The epidemiology of oral diseases in older adults. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of Geriatric Dentistry.* 2nd edition. pp. 263-301. Copenhagen: Munksgaard.

Kay, E.J. and Blinkhorn, A.S. (1987) Some factors related to dentists' decisions to extract teeth. *Community Dental Health* **4**: 3-9.

Kaz, M.E. and Schuchman, L. (1988) Oral health care attitudes of nursing assistants in long term care facilities. *Special Care in Dentistry* **8**: 228-231.

Kidd, E.A.M. (1989) Root caries. *Dental Update* **16**: 93-100.

Kitamura, M., Kiyak, H.A. and Mulligan, K. (1986) Predictors of root caries in the elderly. *Community Dentistry and Oral Epidemiology* **14**: 34-38.

Kite, K. (1995) Changing mouth care practice in intensive care: implications of the clinical setting context. *Intensive Care and Critical Care Nursing* **11**: 203-209.

Kiyak, H.A. (1988) Impact of patients' and dentists' attitudes on older persons' use of dental services. *Gerodontics* **4**: 331-335.

Kiyak, H.A. (1989) Reducing barriers to older persons' use of dental services. *International Dental Journal* **39**: 95-102.

Kiyak, H.A., Grayston, M.N. and Crinean, C.L. (1993) Oral health problems and needs of nursing home residents. *Community Dentistry and Oral Epidemiology* **21**: 49-52.

Knabe, C. and Kram, P. (1997) Dental care for institutionalised geriatric patients in Germany. *Journal of Oral Rehabilitation* **24**: 909-912.

Kuramoto, A.M. (1974) Oral care for the hospitalised patient: a review of nursing research literature. *Michigan Nurse* **47**: 6-8.

Lappalainen, R., Widström, E. and Markkanen, H. (1988) Periodontal condition, remaining teeth and dental health habits of the aged in Finland. *Gerodontics* **4**: 277-279.

Lenox, J.A. and Kopczyk, R.A. (1973) A clinical system for scoring a patient's oral hygiene performance. *Journal of the American Dental Association* **86**: 849-852.

Lester, V., Ashley, F.P. and Gibbons, D.E. (1998) Reported dental attendance and perceived barriers to care in frail and functionally dependent older adults. *British Dental Journal* **184**: 285-289.

Levine, R.S. (1996) The scientific basis of health education. 4th edition, London: Health Education Authority.

Lewis, I.A. (1984) Developing a research-based curriculum: an exercise in relation to oral care. *Nurse Education Today* **3**: 143-144.

Ley, E.S. and Langsjoen, O.M. (1985) Dental care for the elderly. *Gerodontology* **4**: 31-33.

Limeback, H. (1988) The relationship between oral health and systemic infections among elderly residents of chronic care facilities: a review. *Gerodontology* **7**: 131-137.

Llewelyn, J. and Addy, M. (1979) A photographic method for the assessment of examiner accuracy and variability for the scoring criteria of the Debris Index. *Journal of Periodontology* **50**: 84-89.

Lloyd, H. (1990) The dental needs of residents in part III accommodation and carers' attitudes to oral health. MSc. Dissertation: University of London.

Locker, D. (1989) *An introduction to behavioural science and dentistry.* pp. 60-61 and 89-93. Tavistock: Routledge.

Locker, D. (1992) The burden of oral disorders in a population of older adults. *Community Dental Health* **9**: 109-124.

Locker, D. and Leake, J.L. (1993) Coronal and root decay experience in older adults in Ontario, Canada. *Journal of Public Health Dentistry* **53**: 158-164.

Locker, D. and Liddell, A.M. (1991) Correlates of dental anxiety among older adults. *Journal of Dental Research* **70**: 198-203.

Loesche, W.J., Schork, A., Terpenning, M.S., Chen, Y-M., Dominguez, B.L. and Grossman, N. (1998) Assessing the relationship between dental disease and coronary heart disease in elderly US veterans. *Journal of the American Dental Association* **129**: 301-311.

Logan, H.L., Ettinger, R.L., McLeran, H. and Casko, R. (1991) Common misconceptions about oral health in the older adult: nursing practices. *Special Care in Dentistry* **11**: 243-247.

Longhurst, R.H. (1998) A cross-sectional study of the oral healthcare instruction given to nurses during their basic training. *British Dental Journal* **184**: 453-457.

Love, W.D., Goska, F.A. and Mixson, R.J. (1967) The etiology of mucosal inflammation associated with dentures. *Journal of Prosthetic Dentistry* **18**: 515-527.

Löe, H., Theilade, E. and Jensen, S.B. (1965) Experimental gingivitis in man. *Journal of Periodontology* **36**: 177-187.

MacEntee, M.I. (1994) How severe is the threat of caries to old teeth? *Journal of Prosthetic Dentistry* **71**: 473-477.

MacEntee, M.I., Dowell, T.B. and Scully, C. (1988) Oral health concerns of an elderly population in England. *Community Dentistry and Oral Epidemiology* **16**: 72-74.

MacEntee, M.I. and Scully, C. (1988) Oral disorders and treatment implications in people over 75 years. *Community Dentistry and Oral Epidemiology* **16**: 271-273.

MacEntee, M.I., Silver, J.G., Gibson, G. and Weiss, R. (1985) Oral health in a long-term care institution equipped with a dental service. *Community Dentistry and Oral Epidemiology* **13**: 260-263.

Manderson, R.D. and Ettinger, R.L. (1975) Dental status of the institutionalised elderly population of Edinburgh. *Community Dentistry and Oral Epidemiology* **3**: 100-107.

Mann, J., Cross-Poline, G., Holtzman, J.M. and Kaplan, R. (1988) Dental hygienists' and dental hygiene students' attitudes toward the elderly. *Gerodontology* **7**: 81-85.

Mattila, K.J., Nieminen, M.S., Valtonen, V.V., Rasi, V.P., Kesäniemi, Y.A., Syrjälä, S.L., Jungell, P.S., Isoluoma, M., Hietaniemi, K., Jokinen, M.J. and Huttunen, J.K. (1989) Association between dental health and acute myocardial infarction. *British Medical Journal* **298**: 779-782.

McCabe, J.F., Murray, I.D., Laurie, J. and Kelly, P.J. (1996) A method for scoring denture plaque. *European Journal of Prosthodontics and Restorative Dentistry.* **4**: 59-64.

McCord, J.F. and Connolly, M. (1997) Factors influencing the medical condition of hospitalised elderly patients. *Gerodontology* **14**: 60(Abstract)

McCord, J.F. and Stalker, A. (1988) Brushing up on oral care. *Nursing Times* **84**: 40-41.

McCord, J.F. and Wilson, M.C. (1994) Social problems in geriatric dentistry: an overview. *Gerodontology* **11**: 63-66.

McCusker, M.L., Shuman, S.K. and Irvine, P.W. (1996) Medical issues in the dental care of older adults. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of geriatric dentistry.* 2nd edition. pp. 194-211. Copenhagen: Munksgaard.

Merelie, D.L. and Heyman, B. (1992) Dental needs of the elderly in residential care in Newcastle-upon-Tyne and the role of formal carers. *Community Dentistry and Oral Epidemiology* **20**: 106-111.

Mersel, A. (1989) Oral health status and dental needs in a geriatric institutionalised population in Paris. *Gerodontology* **8**: 47-51.

Minkler, M. (1984) Health promotion in long-term care: a contradiction in terms? *Health Education Quarterly* **11**: 77-89.

Miyazaki, H., Shirahama, R., Ohtani, I., Shimada, N. and Takehara, T. (1992) Oral health conditions and denture treatment needs in institutionalised elderly people in Japan. *Community Dentistry and Oral Epidemiology* **20**: 297-301.

Mojon, P., Favre, P., Chung, J.P. and Budtz-Jørgensen, E. (1995) Examiner agreement on caries detection and plaque accumulation during dental surveys of elders. *Gerodontology* **12**: 49-55.

Mojon, P., Budtz-Jørgensen, E., Michel, J.-P. and Limeback, H. (1997) Oral health and history of respiratory tract infection in frail institutionalised elders. *Gerodontology* **14**: 9-16.

Moore, J. (1995) Assessment of nurse-administered oral hygiene. *Nursing Times* **91**: 40-41.

Morse, R. and Jenkinson, D. (1995) Achieving high quality long-term care for elderly people: consumers' wishes and providers' responsibilities. *Journal of the Royal College of Physicians* **29**: 239-241.

Munday, P. and Gelbier, S. (1984) Provision of dental health education in nurse training. *Nurse Education Today* **3**: 124-125.

Nazarko, L. (1996) Nursing home nurses need support to update skills. *Nursing Times* **92**: 38-40.

Nettleton, S. (1995) Protecting a vulnerable margin: towards an analysis of how the mouth came to be separated from the body. In: Davey, B., Gray, A. and Seale, S. (Eds.) *Health and disease: a reader.* 2nd edition. pp. 62-68. Buckingham: Open University Press.

Newton, A.V. (1962) Denture sore mouth. *British Dental Journal* **112**: 357-360.

NHS Executive (1997) Primary Dental Care Services. *Health Services Guidelines HSG(97)4.*

Nicholson, R.J., Stark, M.M. and Scott, H.E. (1968) Calculus and stain removal from acrylic resin dentures. *Journal of Prosthetic Dentistry* **20**: 326-329.

Nicolaci, A.B. and Tesini, D.A. (1982) Improvement in the oral hygiene of institutionalised mentally retarded individuals through training of direct care staff: a longitudinal study. *Special Care in Dentistry* **2**: 217-221.

O'Leary, T. (1967) The periodontal screening examination. *Journal of Periodontology* **38**: 617-624.

Office for National Statistics (1998) Social Trends. 28, pp. 29-139. London: The Stationery Office.

Office for National Statistics (1997) Population Trends. 87, pp. 42-57. London: The Stationery Office.

Oppenheim, A.N. (1992) Questionnaire design, interviewing and attitude measurement. pp. 100-186, 280-281. London: Pinter Publishers Limited.

Ostwald, S.K., Snowden, D.A., Rysavy, S.D.M., Keenan, N.L. and Kane, R.L. (1989) Manual dexterity as a correlate of dependency in the elderly. *Journal of the American Geriatric Society* **37**: 963-969.

Palin-Palokas, T. (1990) Perceptions about oral health and utilisation of oral health care services among urban Finish elderly. *Gerodontology* **9**: 103-109.

Palmer, J.D. (1977) Dental care for elderly patients. *British Dental Journal* **143**: 59-61.

Payne, B.J., Ford, J.C. and Locker, D. (1995) Loss to follow-up in a longitudinal oral health survey of older adults. *Community Dentistry and Oral Epidemiology* **23**: 297-302.

Pearson, A., Hocking, S., Mott, S. and Riggs, A. (1992) Skills mix in Australian nursing homes. *Journal of Advanced Nursing* **17**: 767-776.

Pearson, A., Hocking, S., Mott, S. and Riggs, A. (1993) Quality of care in nursing homes: from the resident's perspective. *Journal of Advanced Nursing* **18**: 20-24.

Pearson, L.S. (1996) A comparison of the ability of foam swabs and toothbrushes to remove dental plaque: implications for nursing practice. *Journal of Advanced Nursing* **23**: 62-69.

Pietrokovski, J., Levy, F., Azuelos, Y., Tau, S., Tamari, I. and Mostavoy, R. (1990a) Oral findings in elderly nursing home residents in selected countries: II. Soft tissue lesions and denture wearing habits. *Gerodontology* **9**: 75-81.

Pietrokovski, J., Tamari, I., Mostavoy, R., Levy, F., Azuelos, Y. and Tau, S. (1990b) Oral findings in elderly nursing home residents in selected countries: I. *Gerodontology* **9**: 67-73.

Pietrokovski, J., Azuelos, Y., Tau, S. and Mostavoy, R. (1995) Oral findings in elderly nursing home residents in selected countries: oral hygiene conditions and plaque accumulations on denture surfaces. *Journal of Prosthetic Dentistry* **73**: 136-141.

Pindborg, J.J. and Holmstrup, P. (1996) Pathology and treatment of diseases in oral mucous membranes and salivary glands. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of Geriatric Dentistry.* 2nd edition. pp. 406-428. Copenhagen: Munksgaard.

Pisanty, S., Mersel, A. and Markitziu, A. (1989) Oral soft tissue status in an elderly institutionalised population. *Gerodontology* **8**: 59-62.

Power, P.A. (1990) Shared responsibility for oral health in long-term care facilities. *Special Care in Dentistry* **10**: 164-165.

Quigley, G.A. and Hein, J.W. (1962) Comparative cleansing efficiency of manual and power brushing. *Journal of the American Dental Association* **65**: 26-29.

Quinn, G. and Freeman, R. (1991) Health visitors as dental health educators: their knowledge, attitudes and behaviour. *Health Education Journal* **50**: 191-194.

Quinn, M.J. (1988) Establishing a preventive dentistry programme in a long-term health care institution. *Gerodontics* **4**: 165-167.

Rak, O.S. and Warren, K. (1990) An assessment of the level of dental and mouthcare knowledge amongst nurses working with elderly patients. *Community Dental Health* **7**: 295-301.

Ramfjord, S.P. (1956) The periodontal disease index (PDI). *Journal of Periodontology* **38**: 602-609.

Resnick, N.M. and Feigenbaum, L.Z. (1992) Geriatric medicine and the elderly patient. In: Schroeder, S.A., Tierney, L.M.J., McPhee, S.J., Papadakis, M.A. and Krupp, M.A. (Eds.) *Current medical diagnosis and treatment.* pp. 21-38. Norwalk, Connecticut: Appleton & Lange.

Richardson, J.P. (1992) Health promotion for the nursing home patient. *Journal of the American Board of Family Practitioners* **5**: 127-136.

Ritchie, G.M. (1973) A report of dental findings in a survey of geriatric patients. *Journal of Dentistry* **1**: 106-112.

Roberts, H., Bali, B. and Rushton, L. (1996) Non-responders to a lifestyle survey: a study using telephone interviews. *Journal of the Institute of Health Education* **34**: 57-61.

Robertson, J.F. (1991) Promoting health among the institutionalised elderly. *Journal of Gerontological Nursing* **17**: 15-19.

Scannapieco, F.A. and Mylotte, J.M. (1996) Relationships between periodontal disease and bacterial pneumonia. *Journal of Periodontology* **67**: 1114-1122.

Schou, L. and Eadie, D. (1991) Qualitative study of oral health norms and behaviour among elderly people in Scotland. *Community Dental Health* **8**: 53-58.

Schou, L., Wight, C., Clemson, N., Douglas, S. and Clark, C. (1989) Oral health promotion for institutionalised elderly. *Community Dentistry and Oral Epidemiology* **17**: 2-6.

Schou, L., Wight, C. and Cumming, C. (1987) Oral hygiene habits, denture plaque, presence of yeasts and stomatitis in institutionalised elderly in Lothian, Scotland. *Community Dentistry and Oral Epidemiology* **15**: 85-89.

Schwartz, D. and Lellouch, J. (1967) Explanatory and pragmatic attitudes in therapeutical trials. *Journal of Chronic Disease* **20**: 637-648.

Schweiger, J.L., Lang, J.W. and Schweiger, J.W. (1980) Oral assessment: how to do it. *American Journal of Nursing* **80**: 654-657.

Shay, K. and Ship, J.A. (1995) The importance of oral health in the older patient. *Journal of the American Geriatrics Society* **43**: 1414-1422.

Sheiham, A. (1983) Promoting periodontal health - effective programmes of education and promotion. *International Dental Journal* **33**: 182-186.

Sheiham, A. (1990) Dentistry for an ageing population: responsibilities and future trends. *Dental Update* **17**: 70-76.

Sheiham, A. and Croog, S.H. (1981) The psychosocial impact of dental diseases on individuals and communities. *Journal of Behavioral Medicine* **4**: 257-272.

Sheridan, J.E., White, J. and Fairchild, T.J. (1992) Ineffective staff, ineffective supervision or ineffective administration? Why some nursing homes fail to provide adequate care. *The Gerontologist* **32**: 334-341.

Ship, J.A. and Ship, I.I. (1989) Trends in oral health in the aging population. *Dental Clinics of North America* **33**: 33-42.

Shiroyama, C., McKee, L. and McKie, L. (1995) Evaluating health promotion projects in primary care: recent experiences in Scotland. *Health Education Journal* **54**: 226-240.

Shlossman, M., Knowler, W.C., Pettitt, D.J. and Genco, R.J. (1990) Type 2 diabetes mellitus and periodontal disease. *Journal of the American Dental Association* **121**: 532-536.

Slots, J. (1977) The predominant cultivable microflora of advanced periodontitis. *Scandinavian Journal of Dental Research* **85**: 114-121.

Smith, J.M. (1979) Oral and dental discomfort - a necessary feature of old age? *Age and Ageing* **8**: 25-31.

Smith, J.M. and Sheiham, A. (1979) How dental conditions handicap the elderly. *Community Dentistry and Oral Epidemiology* **7**: 305-310.

Søgaard, A.J., Grytten, J. and Holst, D. (1991) Recent changes in health related dental behaviors in Norway. *Community Dentistry and Oral Epidemiology* **19**: 241-245.

Soh, G. (1992) Disparity between medical and dental care of institutionalised elderly in Singapore. *International Dental Journal* **42**: 97-102.

Steele, J.G., Walls, A.W.G., Ayatollahi, S.M.T. and Murray, J.J. (1996) Major clinical findings from a dental survey of elderly people in three different English communities. *British Dental Journal* **180**: 17-23.

Steele, J.G., Walls, A.W.G. and Murray, J.J. (1995) Methodological issues involved in sampling a population of the elderly for a dental survey. *Community Dental Health* **12**: 77-82.

Stephens, J. (1997) Oral health teaching within the nursing profession. Unpublished student hygienist project, Bristol Dental Hospital School of Dental Hygiene.

Stephenson, H. (1995) Dentistry for people with special needs. Dental Practice, May 18, p34.

Stockwell, A.J. (1987) Survey of the oral health needs of institutionalised elderly patients in Western Australia. *Community Dentistry and Oral Epidemiology* **15**: 273-276.

Strauss, R.P. and Hunt, R.J. (1993) Understanding the value of teeth to older adults: influences on the quality of life. *Journal of the American Dental Association* **124**: 105-110.

Strayer, M.S. (1993) Dental health among homebound elderly. *Journal of Public Health Dentistry* **53**: 12-16.

Strayer, M.S. (1995) Perceived barriers to oral health care among the homebound. *Special Care in Dentistry* **15**: 113-118.

Strayer, M.S. and Ibrahim, M.F. (1991) Dental treatment needs of homebound and nursing home patients. *Community Dentistry and Oral Epidemiology* **19**: 176-177.

Stuck, A.E., Chappuis, C., Flury, H. and Lang, N.P. (1989) Dental treatment needs in an elderly population referred to a geriatric hospital in Switzerland. *Community Dentistry and Oral Epidemiology* **17**: 267-272.

Suomi, J.D. and Barbano, J.P. (1968) Patterns of gingivitis. *Journal of Periodontology* **39**: 71-74.

Tarbet, W.J. (1982) Denture plaque: quiet destroyer. *Journal of Prosthetic Dentistry* **48**: 647-652.

Tervonen, T. and Knuuttila, M. (1988) Awareness of dental disorders and discrepancy between "objective" and "subjective" dental treatment needs. *Community Dentistry and Oral Epidemiology* **16**: 345-348.

Thai, P.H., Shuman, S.K. and Davidson, G.B. (1997) Nurses' dental assessments and subsequent care in Minnesota nursing homes. *Special Care in Dentistry* **17**: 13-18.

Theilade, E. and Theilade, J. (1976) Role of plaque in the etiology of periodontal disease and caries. *Oral Sciences Review* **9**: 23-63.

Thines, T., Karuza, J. and Miller, W.A. (1987) Oral health impact on quality of life: methodological and conceptual concerns. *Gerodontics* **3**: 100-102.

Timms, J. and Ford, P. (1995) Registered nurses' perceptions of gerontological continuing education needs in the United Kingdom and in the USA. *Journal of Advanced Nursing* **22**: 300-307.

Tobias, B. and Smith, D.M.H. (1990) Dental screening of long stay geriatric patients in West Essex and recommendations for their care. *Community Dental Health* **7**: 93-98.

Tobias, B. and Smith, J.M. (1987) Barriers to dental care, and associated oral status and treatment needs, in an elderly population living in sheltered accommodation in West Essex. *British Dental Journal* **163**: 293-295.

Todd, J.E. (1990) Care in private homes. London: HMSO.

Todd, J.E. and Lader, D. (1991) Adult Dental Health Survey 1988. pp. 11, 51-58, 76, 143, 165, 196, 206-207. London: HMSO.

Tones, K. and Tilford, S. (1994) *Health education: effectiveness, efficiency and equity.* 2nd edition. pp. 1-48. London: Chapman & Hall.

Trenter Roth, P. and Creason, N.S. (1986) Nurse administered oral hygiene: is there a scientific basis? *Journal of Advanced Nursing* **11**: 323-331.

U.S. Surgeon General (1988) Recommendations for oral health promotion activities with older adults. *Gerodontics* **4**: 207-208.

United Kingdom working group on screening for oral cancer and pre-cancer (1993) Conclusions and recommendations. *Community Dental Health* **10** (Supplement 1): 87-89.

Vigild, M. (1987) Oral mucosal lesions among institutionalised elderly in Denmark. *Community Dentistry and Oral Epidemiology* **15**: 309-313.

Vigild, M. (1988) Oral hygiene and periodontal conditions among 201 dentate institutionalised elderly. *Gerodontics* **4**: 140-145.

Vigild, M. (1989) Dental caries and the need for treatment among institutionalised elderly. *Community Dentistry and Oral Epidemiology* **17**: 102-105.

Vigild, M. (1990) Evaluation of an oral health service for nursing home residents. *Acta Odontologica Scandinavia* **48**: 99-105.

Vigild, M. (1992) Oral health care programmes for elderly in Scandinavia. *International Dental Journal* **42**: 323-329.

Vigild, M. (1993) Benefit related assessment of treatment need among institutionalised elderly people. *Gerodontology* **10**: 10-14.

Viidik, A. (1996) The biological basis of aging. In: Holm-Pedersen, P. and Löe, H. (Eds.) *Textbook of Geriatric Dentistry.* 2nd edition. pp. 21-37. Copenhagen: Munksgaard.

Vogel, C.H. and Mercier, J. (1991) The effect of institutionalisation on nursing home populations. *Journal of Gerontological Nursing* **17**: 30-34.

Waldman, H.B. (1967) The problems of nursing home dental care. *Journal of the American Dental Association* **74**: 423-425.

Wallace, K.G., Koeppel, K., Senko, A., Stawiaz, K., Thomas, C. and Kosar, K. (1997) Effect of attitudes and subjective norms on intention to provide oral care to patients receiving antineoplastic chemotherapy. *Cancer Nursing* **20**: 34-41.

Wallace, M.C., Retief, D.H. and Bradley, E.L. (1988) Prevalence of root caries in a population of older adults. *Gerodontics* **4**: 84-89.

Wallack, S.S. and Cohen, M.A. (1988) Costs of long term care. In: *Research and the ageing population.* (CIBA Symposium 134) pp. 245-253. Chichester: Wiley.

Walls, A.W.G. and Barnes, I.E. (1988) Gerodontology: the problem. *Dental Update* **15**: 186-191.

Ward-Booth, P. (1988) Oral surgery for the older patient. *Dental Update* **15**: 410-417.

Wårdh, I., Andersson, L. and Sörensen, S. (1997) Staff attitudes to oral health care: a comparative study of registered nurses, nursing assistants and home care aides. *Gerodontology* **14**: 28-32.

Weeks, J.C. and Fiske, J. (1994) Oral care of people with a disability: a qualitative exploration of the views of nursing staff. *Gerodontology* **11**: 13-17.

Wetle, T. (1987) Ethical issues in geriatric dentistry. *Gerodontology* **6**: 73-78.

Weyant, R.J., Jones, J.A., Hobbins, M., Niessen, L.C., Adelson, R. And Rhyne, R.R. (1993) Oral health status of a long-term-care veteran population. *Community Dentistry and Oral Epidemiology* **21**: 227-233.

Wilde, B., Larsson, G., Larsson, M. and Starrin, B. (1995) Quality of care from the elderly person's perspective: subjective importance and perceived reality. *Aging (Milano)* **7**: (2):140-149.

Wilkieson, C., Samaranayake, L.P., MacFarlane, T.W., Lamey, P-J. and MacKenzie, D. (1991) Oral candidosis in the elderly in long term hospital care. *Journal of Oral Pathology and Medicine.* **20**: 13-16.

Wilson, G.N., Salway, D.J. and McLaughlin, E.A. (1987) The dental needs and demands of an elderly population living in care in south Cumbria. *Community Dental Health* **4**: 395-405.

Woodall, D. (1997) Some oral health education experiences. *Gerodontic Study Group Newsletter* (June): 1